American Machinist

Volume 65 New York, July 29, 1926 Number 5

Are Profit Ideals High Enough?

By K. H. Condit
Editor, *American Machinist*

A collection of statements by leading industrial executives giving their ideas on how selling prices should be established

"STUNNED" is a mild word to express the condition of a group of machine tool builders when they were told at a recent meeting that their profit ideals were too low and, further, that their profits should amount to 100 per cent of conversion cost. Conversion cost was defined as direct labor, supervisory overhead and fixed overhead. Material cost and sales expense were not included in conversion cost.

There was so much discussion of this theory of determining profits that we have thought it worth while to find out from the heads of some of America's largest industrial machinery building corporations what they thought of the theory and how it squared with their own practice.

Some of these gentlemen point out that profit ideals are practically inseparable from market conditions established to a large extent by aggressive competition. Every one will admit the truth of this contention but the question then arises, is it worth while to continue competing in a market so crowded that a reasonable profit is not obtainable? Apparently this phase of the problem is occasionally overlooked or ignored.

There seems to be general objection to leaving out material cost when calculating the basis of profit. Perhaps this objection arises as a result of the long-established custom of speculating in raw materials, perhaps not.

As the following statements were secured under a promise that no names would be published it is not possible to identify the various ones. Taken as a whole they are thoroughly representative of the thinking of leaders of this particular field. Discussion of their views will be welcomed by the contributors and by the editor.

Selling Prices Based on Conversion Costs Show Wide Variations in Plants of One Company

"My assistant worked out the figures of four of our plants in connection with the 100 per cent profit theory with the results expressed in the four equations that follow.

"In this computation we have considered the conversion cost as including labor plus the supervisory and other expenses ordinarily known as shop expenses, and we have assumed that the 100 per cent addition would cover selling and general administrative overhead and profit.

"The selling price would then consist of cost of materials plus conversion cost plus 100 per cent of conversion cost.

"Now let us see how the selling prices of the product of four plants A, B, C and D compare with this formula.

Plant A Selling Price = Materials + Conversion Cost + 79 per cent

Plant B Selling Price = Materials + Conversion Cost + 90⅞ per cent

Plant C Selling Price = Materials + Conversion Cost + 102 per cent

Plant D Selling Price = Materials + Conversion Cost + 154⅛ per cent

"Plants B and C are somewhat similar in product, although the expense of selling the product of Plant C is somewhat higher than the expense of selling at Plant B.

"Plant D is confined to the manufacture of a highly repetitive product with a low labor cost, but a relatively high cost of distributing and selling.

"The 100 per cent theory assumes that there is a definite relation between conversion cost and general overhead, which is a fallacy. Things that are cheap to make may be expensive to advertise and sell. Improved methods of manufacture resulting in lower conversion cost do not simultaneously bring corresponding reductions in the cost of selling and administrative overhead.

"There cannot exist a definite relationship between conversion cost and general overhead and the theory is, therefore, unsound. While I agree with your theorist that the profit ideals of the average manufacturer are too low, that is due largely to inaccurate information concerning both direct and indirect costs. But would matters be improved if a guess were substituted for inaccurate information?

"There is no empirical formula that I know of that can safely be substituted for a sensible application of a good cost system. This 100 per cent profit formula will simply increase the number of manufacturers, now already too large, who think they can save money by doing without a cost accountant.

"In business the manufacturer too often supposes while the buyer disposes. If more manufacturers based their price policies on actual cost knowledge, there would be a lower per cent of mortality both in industry and in business."

Progress of Standardization in Cost Determination Makes Change to Conversion Cost Basis Inadvisable

"The idea of basing profit on conversion cost has been considered in a general way from time to time by various accounting associations. Its application, however, has apparently been limited to those industries in which the material cost is but a small percentage of the total value. The development of accounting in recent years has tended to conform to the objectives of all business practice in striving for a maximum degree of standardization. The best opinion with which we are in touch seems to feel that too much headway has been made in recent years through such standardization of cost methods to justify consideration, at this time, of any change as the proposed 'conversion' method.

"The engineer of whom you speak is perfectly correct in his statement that profit ideals of the average manufacturer are too low, but this situation can be readily changed by simply adding a larger percentage of profit while continuing to pursue the present basis of cost determination.

"We strongly recommend, therefore, the generally accepted practice of including in the cost of manufacture the material values which in a large number of industries form a large part of the manufacturing investment. The relative value of materials used is as much a factor in the various processes of manufacture as is the conversion cost.

"We further recommend that each particular industry face its facts as it finds them, and while pursuing unceasing vigilance in the reduction of all elements of the cost structure, that it safeguard its present and future welfare by adding an adequate margin of profit. If vigorously and continuously pursued, the two flanking elements of cost reduction and profit margin should support and supplement one another effectively.

"This reference to cost reduction is a little off the point of your inquiry, but is so closely bound up with the profit angle that I could not avoid bringing it into the picture."

Conversion Cost Profit Basis Would Create Wide Fluctuations if Work Going Through Shop Changed Frequently

"Replying to your letter with reference to the suggestion that in making prices of a manufactured product the price should be so made that profit to the manufacturer is 100 per cent of the conversion cost. I know nothing of costs in industries other than that in which I am engaged, and as far as I know manufacturers in this particular industry base their profits on the total material, labor and overhead cost. Competition is keen and profits relatively small. Even assuming what might be regarded as a fair profit, namely, 15 per cent on the total cost, the profit so obtained is approximately only half of that which would be obtained if the profit were figured at 100 per cent of the conversion cost. This is due to the percentage which the material cost bears to the total cost.

"Looking at this problem from a broad viewpoint I should say that in pricing machinery it is best to figure profits based on the total cost; first, because total cost and not cost of conversion represents the manufacturer's liability; second, because of the variation in conversion cost in proportion to total cost in the manufacture of different kinds of articles. In machine tool work, for instance, the labor cost per pound on a bed plate is very much less than that on the gears. If, for some reason, instead of a fairly average relative amount of heavy parts with relatively little machining, the nature of the work going through the shop were to change so that the work were all heavy or all light or nearly so, the profits would be very different even though the total actual cost of production might be the same.

"I feel that in the settlement of this question the nature of the operations performed and the continuity of such operations have more to do with the proper basis of pricing than any theory on the subject."

Calculates Profit on the Entire Manufacturing and Selling Costs of the Product

"I have read with interest your letter setting forth the claims of a consulting engineer in regard to establishing the selling prices of manufactured products. It is difficult to agree with the statement made, for I believe that no definite rules as to the amount of profit to be added can be applied to as wide a range of commodities as is covered by the description 'manufactured product.'

"The manufacture of certain commodities may involve a high raw material and selling cost with a small conversion expense and to apply the profit only on the latter would be to produce too low a rate of profit with the result that such a profit might preclude profitable business operations until there was a sufficient volume of business to produce the desired earnings. On the other hand, in the manufacture of other commodities, the raw material cost and the selling expense might be comparatively small and the addition of a profit equal to the conversion cost might result in a prohibitive selling price.

"In some instances of patented articles, the profit added could properly have no reference to the cost of manufacture as the idea sold with the article might be worth to the consumer many times the actual production and selling costs. The allowable percentage of profit in such instances might readily be absolutely prohibitive in others.

"The statement is made that 'the profit ideals of the average manufacturer are entirely too low as indicated by the large number of corporations that fail to make any money.' It is my belief that in the majority of cases this failure can be attributed to such other causes as inefficient management, lack of knowledge of manufacturing costs, business depression, failure to allow proper organization expenses and many other things. Rarely would it be due to a failure to add sufficient 'profit.'

In our own business the profit included in our selling prices is calculated with but very few exceptions on the entire manufacturing and selling costs with more or less definite rules respecting the various percentages of profit to be added."

Profit Should be Sufficient to Attract Additional Capital as Needed

"It seems to me that your correspondent is all at sea in stating that the profits should be 100 per cent of the conversion cost; the conversion cost being defined as including labor and the necessary factory overhead, not including raw material or sales expense.

"This conception may be all right for an engineer, but I should prefer to write on the matter from the point of view of the economist. Speaking from that standpoint it seems to me that the profit should be sufficient to enable the company to secure the necessary additional capital to provide for its expansion and growth from time to time; and also to enable it to set up an adequate reserve for depreciation, which reserve should preferably be in cash or in readily marketable securities.

"Of course, I realize that many concerns earn much more than this, and the standard which I am setting up seems to me a minimum to permit of successful operation.

"Some statistical material quoted by Colonel Ayers, of the Cleveland Trust Co., indicates that the average rate of dividend on all industrial dividend-paying stocks is in the neighborhood of 7 per cent. This would mean that a stock must pay at least 7 per cent to enable the company to secure additional capital at a reasonable cost.

"In addition, it seems to me the depreciation reserve should range from 5 to 10 per cent per annum on machinery and equipment, and from 2 to 3 per cent on buildings, according to the nature of the business, and the profitable life of the equipment. It seems to me that there is no necessary connection whatever between such a profit and the 'conversion cost' as defined by your correspondent.

"In our own business, basing our figures on the rate of turnover or capital, which turns over in sales in about 1½ to 2 years, we have formed a goal to aim at, of securing a profit of 20 per cent of the sales price. This would yield us a satisfactory profit, and would provide proper dividends and depreciation reserve.

"Of course, it does not follow by any means that we are always able to realize such a profit, but we hold it as a mark to shoot at, and come as near as we can."

Ideals Are Not Too Low But Fail of Realization Through Action of Economic Laws

"This is a very astonishing statement. It is surprising that this statement should be made because of the fact that sales and administration expense varies so widely in various classes of manufactured articles. On some it is as low as 6 per cent; on others it is as high as 40 per cent. The true percentage is affected also by the ratio of raw materials to productive labor, and the ratio of each of those elements of cost to supervision and burden. This varies very widely. There are some articles where the raw material cost is 80 per cent of the total. There are other cases where the material cost is 15 per cent of the total.

"The percentage of profit in our own lines varies from 15 to 50 per cent, all dependent on varying conditions as to sales and administration. I do not believe anybody's profit ideals are too low. I think the ideals are high enough, but economic laws wreck the ideal. Now, the economic law that affects profits most largely is the excess of productive capacity over consuming capacity and the lack of profit ideals has nothing to do with a large number of failures to make money. The manufacturer who makes money is the one who furnishes a product that excels the average and whose productive cost is as low or lower than the average, and that at the present time, is the whole story of making money."

Profit Ideals Are too Low Because Insufficient Allowance is Made For Overhead

"Answering your recent letter to say that a manufacturer should add 100 per cent to his cost in fixing the selling price of the product is to imply that the economic conditions in industrial works and selling methods are identical and may be figured by the rule of three. Such, of course, is not the case. Not only do the products themselves vary in cost, but selling conditions, commonly called overhead, are different even among manufacturers dealing in the same product.

"The true course for any manufacturer to pursue is to find out what his cost is, including material, labor and overhead, and to this figure add a fair profit.

"It is quite true that 'profit ideals of the average manufacturer are entirely too low.' This is because men of inexperience do not make sufficient allowance for overhead."

Pouring Babbitt-Metal Bearings—Discussion

By E. Andrews

I have read with interest the article under the title given above published on page 722, Vol. 64, of the *American Machinist* and should like to add a few remarks to what has already been said on this important subject.

It should be remembered that babbitt metal is a mechanical mixture, the successful use of which depends not only upon the correct pouring temperature, but also upon the perfect diffusion of the ingredients throughout the mass. The molten metal should, therefore, be kept thoroughly mixed, especially just prior to pouring, by continually bringing the lower strata up from the bottom of the bath. If allowed to remain still while in the liquid state, the metal tends to separate into layers. The lead, being heaviest, gradually works toward the bottom and the lighter ingredients to the top. Obviously, babbitt-lined bearings, poured from metal in such a state, sooner or later develop trouble in service.

Temperature Is Important

Babbitt metal should be melted slowly in a clean iron vessel or graphite crucible and maintained at a temperature between 830 and 910 deg. F. It is very necessary that the higher temperature be not exceeded at any time, as in certain grades of babbitt the metal is thus irreparably damaged. Where any extensive amount of babbitting is done it is preferable to employ a special type of furnace equipped with a modern device for thoroughly mixing the components of the babbitt. This device generally takes the form of a propeller, the blades of which are rotated in the melting pot by means of a handle. The babbitt is drawn off from the melting pot, which is inclosed, through an outlet at the bottom controlled by means of a screw valve (thereby assuring pure metal without dross or foreign matter) and a thermostatic regulator that acts on the fuel supply and can be set to suit any particular grade of babbitt maintains the metal at the proper temperature for running into the bearings. The quality of the bearings is greatly improved by the uniformity that results from the mixing and by the protection afforded against overheating and burning. Besides, the process is rapid and requires no skilled labor.

Book Reviews

Mathematics and the Machinist's Job. By Frank Cushman. Two hundred and twenty-six pages, 4¾x7 in. Published by John Wiley & Sons, Inc., New York. Price $1.75.

As the name implies, the author has endeavored to fit this book to the needs of the machinist in his work. Assuming that the reader needs brushing up on arithmetic he takes him through the elementary stages and then schools him on the circle and its functions, on the vernier and micrometer and works into belting and belt speeds, leverage, thread cutting and gearing in an easy manner. A chapter is also devoted to the use of four place logarithms.

The second part of the book deals with shop trigonometry and the solution of angles in their various forms, although the examples do not seem to deal with specific shop problems. The book is evidently intended primarily for vocational and trade schools.

Applied Elasticity. By S. Timoshenko and J. M. Lessells. Five hundred and forty pages, 6x9 in. Published by the Westinghouse Technical Night School Press, East Pittsburgh, Pa. Price $6.00.

The volume is divided into two sections, the first devoted to the analytical side of the question and the second to experiments on elasticity, together with references that cover publications in this country, England, Germany and France. These include the effect of chemical analysis of the material, speed of testing, temperature, cold work and overstrain, fatigue and other factors.

The authors point out that the trend of modern industrial development is toward the acceptance and use of the teachings of pure science, and that the engineer of the future must have a deeper scientific training than ever before. It is to aid in such a study of elasticity of materials that this book has been prepared.

It is obviously impossible to review such a volume in sufficient detail to give an adequate idea of the infinite care and patience that have gone into its preparation. The studies include beams, bars, crankshafts, thin plates and the effect of solid and elastic supports. The volume is of necessity highly mathematical and only for such engineers or students as can delve deeply into the subject.

Assuring Business Profits. How to run any business on a big business basis. By James H. Rand, Jr. Two hundred and forty-five pages, 5x7½ in. Published by B. C. Forbes Publishing Co., New York City.

Here is a book that every owner or manager of a business ought to read. He may not agree with all of Mr. Rand's theories but at least they will make him think. The author is the head of the Rand Kardex Co. and his theories have the advantage of having been evolved from practical business experience.

One of the most interesting points in the book is Mr. Rand's infallible method of insuring profits. Perhaps "infallible" is not just the work to use but it is not far wrong because the use of the method results in the immediate liquidation of the business if it fails to make a profit.

The basic principle on which the story is built is the practical application of budgeting to all departments of a business. At the end of each chapter, after the theme has been developed, there are several paragraphs in smaller type telling what records should be kept by the departments involved in order to insure that the governing principles shall be carried out.

A list of the chapter headings follows: The straight line to business success; The manager's job; Insuring business profits; Developing human assets; Planned purchasing; Reducing the cost to make; Developing distribution; Getting new customers without losing old ones; Collecting your profits; Judging the business currents; Putting your dollars to work; Creating your estate.

Die Normung der Gewinde-Systeme. By Dr. G. Schlesinger, Professor in the Charlottenburg Technical College. One hundred sixty-six pages, 6x8 in., heavy cloth boards. 48 cuts and tables. Indexed. Published by the Beuth-Verlag G.M.B.H., Berlin SW 19, Germany. Price 4.25 marks.

This book is No. 2 in the "Dinbuch" (German Industrial Standards Book) series issued by the German Industrial Standards Commmittee. It contains a complete analysis of the screw threads employed in Germany, with designation of the standards for dimensions and tolerances. The threads studied in detail are those of the Metric and the British Whitworth systems. The text is copiously illustrated with diagrams, and complete tables of dimensions are given. A chapter at the end of the book is devoted to a consideration of the standard threads used in the United States and other countries.

Profits. By Willam Trufant Foster and Waddill Catchings. Four hundred sixty-five pages, 5x8 in., cloth. Indexed. Published by Houghton Mifflin Co., New York, for the Pollak Foundation for Economic Research, Newton 58, Mass. Price $4.

This book is the eighth in a series of economic studies on present-day problems of business, finance, and labor. Its argument is based on the assumption that greater and more stable production is hampered by the fact that consumers, who are also the wage earners of industry, do not draw out from industry enough of the profits to maintain throughout the community a continued high rate of buying.

The authors contend that communism and socialism cannot overcome the difficulties and maintain the even flow of goods from producer to consumer, but that greater equalization and stabilization can only be attained by a greater leveling of the profits of industry, thus giving the workman consumer an increased buying power.

The text is illustrated with 61 cuts and 29 tables. The earnings of a number of companies are analyzed, and statistics on wages, profits, savings, and dividends are compared for various years. An attempt is made to prove that in so-called periods of progress industry fills the shelves with goods, much of which is later sold at a loss, and that the saving of any part of the worker's wage is a dead loss to progress by cutting down the consumers' buying capacity. The book is well worth serious study by anyone engaged in productive industry or in the handling of finances, as it attacks a problem that is vital to the present-day business and social organization.

Machining Methods That Cut Locomotive Repair Costs

By Frank W. Curtis
Western Editor, *American Machinist*

Milling shoes and wedges—Planing crossheads—Reboring cylinders—Boring and facing driving boxes—Air-operated tools for squaring valve parts and cutting out superheater flues

SHOES are milled on the outside and inside surfaces at the same time in a No. 5 Cincinnati milling machine, in which a gang of Goddard & Goddard inserted-blade cutters, 12 and 18 in. in diameter, is used. The cut is made at 13 r.p.m. and ¾-in. feed per min., with the removal of approximately ⅛ in. of metal. Fig. 8 illustrates the set-up, and in Fig. 9 are shown details of the fixture. The cast-iron body of the fixture is 4¾ in. in width, so that work varying in size up to 8 in. will overhang on the sides when in position for machining. The tail of an adjustable clamp mounted at one end of the fixture engages with ratchet teeth cut in the fixture itself, the opposite end of the clamp being serrated so as to grip the work and seat it firmly. When the work is in place against the hold-down clamp at the opposite end of the fixture, the adjustable clamp is set against the end of the shoe, its tail engaging with the tooth that offers a proper location. The screw, adjusted from the under part of the fixture, is then turned to clamp the work. The opposite clamp also is tightened to insure that both ends of the work are properly seated. A cross-sectional view of the shoe is shown in the lower-center portion of the illustration. Wedges are milled on a similar fixture that accommodates two pieces.

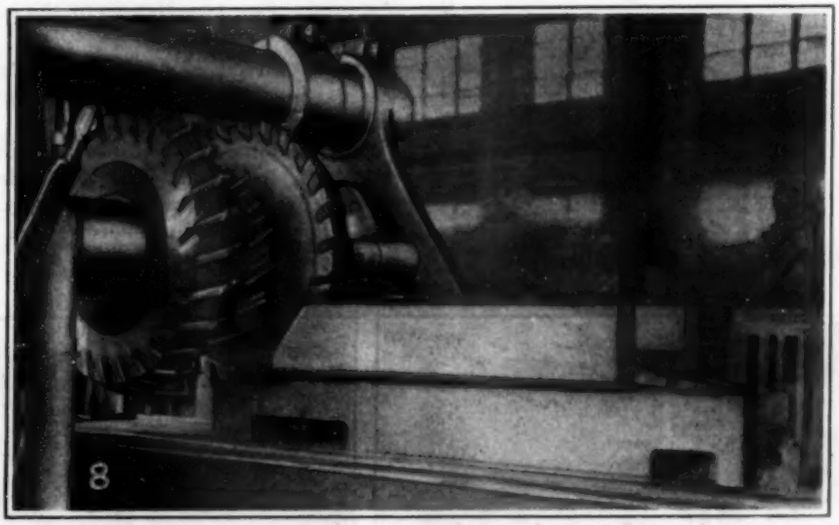


Fig. 8—Straddle-milling a shoe

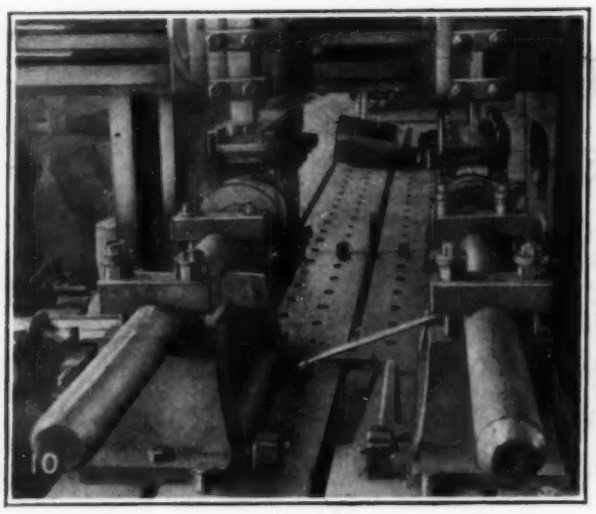
Crossheads are handled in pairs in order to machine them uniformly. The fits for the guides are finished in the Niles-Bement-Pond planer shown in Fig. 10, in which they are supported on mandrels, made from obsolete piston rods. V-blocks and clamps are used to hold the mandrels, and adjustable blocks support the overhanging crossheads. Upon completion of one side, the clamps are released and the work is turned 180 deg., then reclamped and finished correspondingly.

The second article. The third will appear in an early issue.

The condition of worn cylinders is inspected in pairs, for out-of-roundness, tapered bores, and general wear, so that in reconditioning them, the worst one of the pair can be used to govern the size of reboring. An amount of metal just sufficient to clean up and render a true surface is removed, this amount being taken off in a roughing and a finishing cut. Where a bushed cylinder is to be rebored, leaving the bushing too thin, it is removed and a new one substituted.

The method of reboring cylinders is illustrated in Fig. 11. A 5-hp., 220-volt, d.c. Westinghouse motor, operating at a variable speed of from 650 to 1,200 r.p.m., governed by a controller, is mounted on a truck as shown. The Underwood portable cylinder-boring machine, shown in place, is driven by the motor through a shaft equipped with universal joints. When the bores have been completed, the pistons are made to correspond in size. If the necessary increase in the size of the pistons is not too great, the original pistons are built up by welding with bronze, otherwise new pistons must be furnished.

For machining crown brasses after they have been forced into the driving boxes, the Omaha shops of the Union Pacific R.R. Co. use a Moss universal driving-box chuck, mounted in a 42-in. Niles-Bement-Pond boring mill, as illustrated in Fig. 12. The work rests on two parallels so spaced that the boring tool can clear the bottom face of the crown brass. Two jaws, operated by a right- and left-hand screw, grip the box as shown. Between the bottom faces of the chuck jaws and the lower flange of the driving box, are jacks that hold the work down on the parallels. The boring and facing cuts are taken simultaneously, each face requiring a rough and finish cut. A screen guard surrounds the open side of the



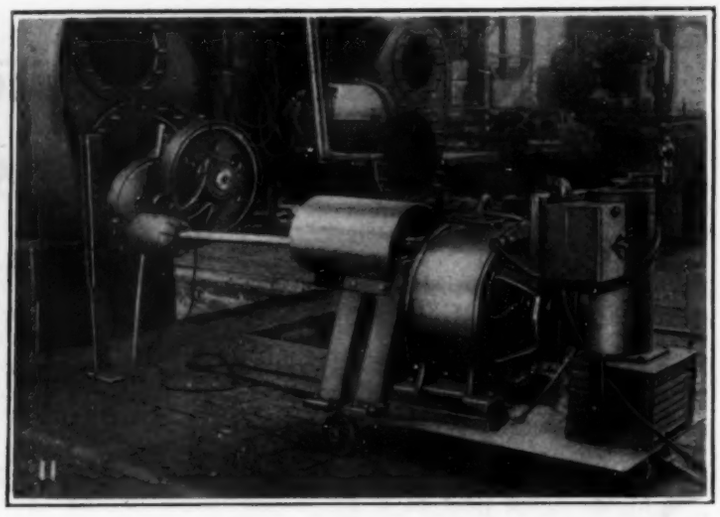


Fig. 10—Machining crossheads in pairs. Fig. 11—Rig for reboring cylinders

machine when in operation to prevent chips from flying about.

Instead of resetting valve bushings for machining the square corners of port holes, the operation is accomplished in the lathe in which they are turned. An air-driven milling attachment, mounted in the tool post, as shown in Fig. 13, is used. The air motor is started and the work is brought against the cutters by revolving the chuck by means of a bar inserted in one of the T-slots, the clutch having been disengaged so the spindle can be revolved easily. Eleven ports, 1½ in. in width and 4½ in. in length, are finished in 14 min. Details of the milling tool are shown in Fig. 14. The body is

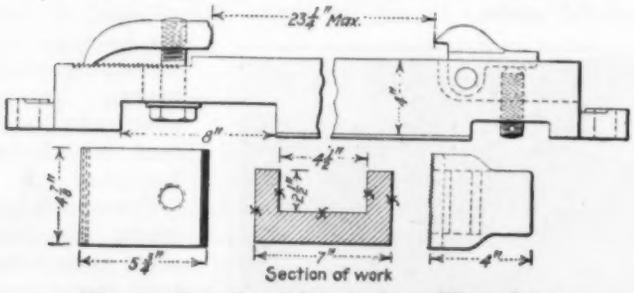


Fig. 9—Details of fixture for milling shoes

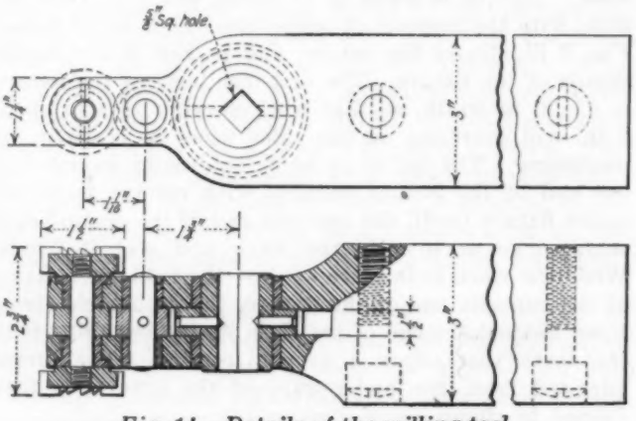
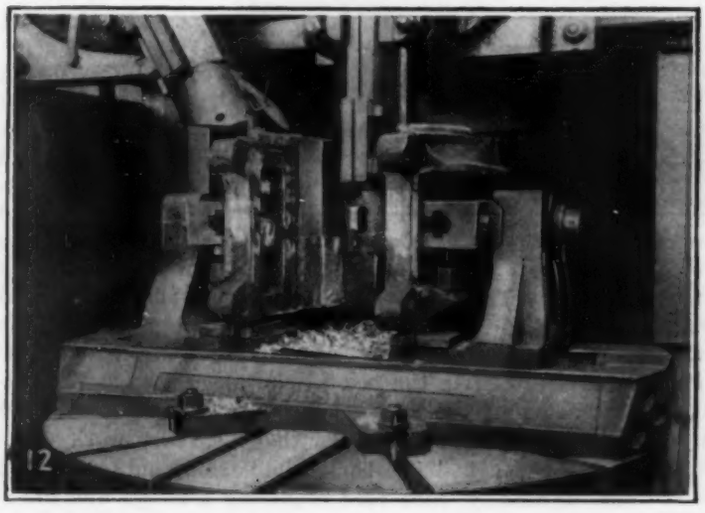


Fig. 14—Details of the milling tool

made in two pieces for ease of assembly. The cutters are driven through a train of gears, the shafts of which run in hardened bushings.

The sectional view shows how the gears are held on the short shafts and how the bushings in which those shafts run are located in the body of the milling tool. The milling cutters are screwed on the ends of the final driving shaft.



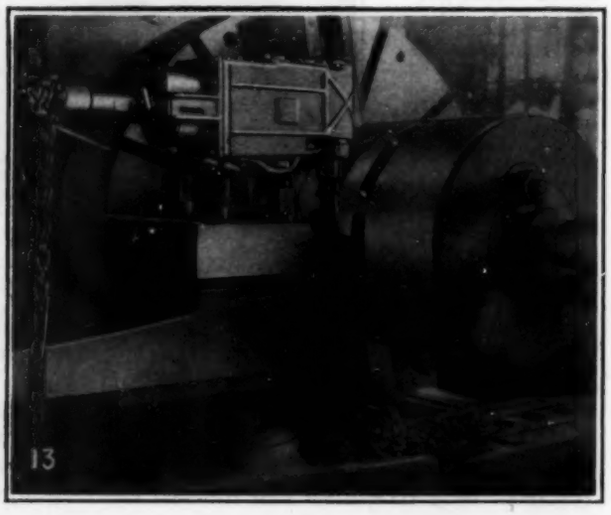


Fig. 12—Boring and facing a driving-box brass. Fig. 13—Squaring port holes in a lathe

The Design of Gear Tooth Forms

By Earle Buckingham
Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

Maag gears—Gear trains—A study of modified pinions of small numbers of teeth of the proportional center distance system — Contact and sliding conditions

THE idea of a system of variable center distance gears to be generated by a single basic rack is not new. In Germany, Hoppe proposed a system of interchangeable gears where the pressure angle was variable, the normal pitch constant, and where the center distances could be taken from a table. Hoppe's system was described by Kammerer in "Zeitschrift des Vereines Deutscher Ingenieure," 1903, page 885. Broadly speaking, Hoppe's suggestions are similar in many ways to the principles which were later followed by Maag.

Maag was probably the first manufacturer to produce commercially involute gears designed to obtain the full benefits of the involute form. The design of these gears follows in general the same principles as have been followed in the foregoing systems. A series of range cutters is employed, with which gears to run at standard or special center distances can be produced with very favorable and well-balanced tooth designs. These gears have been extensively used in Europe for the past twenty years, and in the United States for the past ten years.

The table of outside radii and pressure angles for the range-cutter, proportional center distance system is for use on pairs of gears only. When a train of more than two gears is involved, one of two courses should be followed. If the center distances can be varied, the gears can all be cut with the 14½-deg. cutter, and the center distances be established according to the table of variable center distance gears. For example, if the train of gears had tooth numbers of 35,22,40, and 90 respectively, we would obtain the following center distances and tooth depths from the table of variable center distance gears in the sixteenth article:

Combination	Center distance, in.	Tooth depth, in.
35/22	28.9715	2.1498
22/40	31.3795	2.1703
40/90	65.0000	2.2000

In such cases, each gear should be made with the minimum tooth depth specified for any of its meshes so as not to reduce the clearances. This would give us the following:

Number of teeth	35	22	40	90
Tooth depth, in.	2.1498	2.1498	2.1703	2.2000

When the center distances are fixed, and are proportional to the numbers of teeth, it is best to make the addenda of all the gears in the train equal, and to use the cutter that is required for a pair of the smallest gears in the train. For example, if the train of gears had tooth numbers of 35, 22, 40 and 90 respectively, the 20-deg. cutter should be used as that is the cutter required for a pair of 22-tooth gears. In this case, the addenda of all the gears in the train would be equal to 1.0000 in. If the smallest gear in the train had 16 teeth, the 22½-deg. cutter should be used, and the addenda on all the gears would be 0.9000 inches.

Conditions arise where a pair or train of gears is required to operate on special center distances. For example, we will assume that we wish to make a

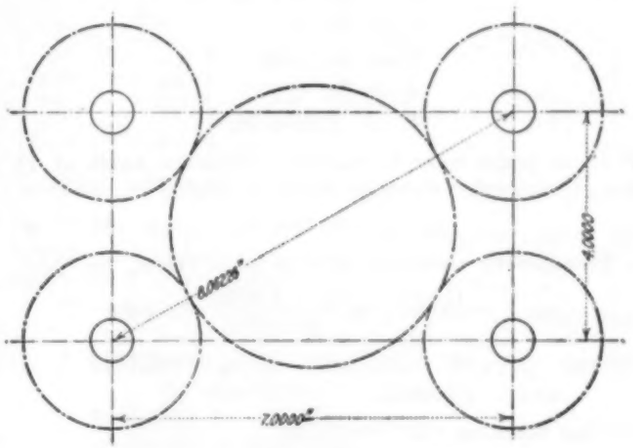


Fig. 80—Gear train for multiple-spindle drilling attachment

multiple-spindle drilling attachment to drill holes as shown in Fig. 80. There will be four spindles, all to be driven by a single gear in the center. The diagonal distance from center to center of these holes is 8.06226 in. One-half of this, or 4.03113 in., will be the center distance between the driving gear and the driven ones on the drill spindles. We will assume that 10-D.P. gears will be strong enough for this drive. The first step would be to reduce this center distance to the corresponding one of 1-D.P. gears because it is simpler always to calculate on the basis of 1-D.P gears. This is done in this example by multiplying by 10, which gives us 40.3113 in. as the center distance for 1-D.P. gears. The nearest smaller sum of teeth for this center distance is 80. In this example, we will therefore make the central gear with 50 teeth, and the gears on the spindles with 30 teeth.

Referring to the table of proportional center distance

The nineteenth and concluding article of this series. The study of gear teeth in action will be considered in another series by the same author in the near future.

gears, Table XIV in the preceding article, we find that these gears would ordinarily be cut with the 17-deg. cutter. We will therefore use this same cutter for these gears.

The next step is to determine the proper root radii for these gears that are to mesh at a special center distance. Referring to Problem 12 in the eighth article, we have:

$$C_1 = \frac{C_2 \cos \alpha_2}{\cos \alpha_1} \qquad \text{[Equation (51)]}$$

$$G + g = C_1 - 2F + \frac{\cot \alpha_1}{2}\left[2C_1\left(\frac{\pi}{N+n} + \text{inv}\,\alpha_2 - \text{inv}\,\alpha_1\right) - CP\right] \qquad \text{[Equation (52)]}$$

Where α_1 = pressure angle of cutter of basic-rack form
α_2 = pressure angle of gears when meshed
C_1 = center distance with pressure angle of α_1
C_2 = center distance with pressure angle of α_2
F = addendum of basic-rack form cutter including clearance
N = number of teeth in gear
n = number of teeth in pinion
CP = circular pitch of rack
G = root radius of gear
g = root radius of pinion.

In this example, we have:

$C_2 = 40.3113$ in.
$\alpha_1 = 17°$
$N = 50$ teeth
$n = 30$ "
$F = 1.2000$ in.

If these gears were to run at a pressure angle of 17 deg., their center distance would be 40.000 in., whence:

$$C_1 = 40.000 \text{ in.}$$

Transposing equation (51) to solve for α_2, we have:

$$\cos \alpha_2 = \frac{C_1 \cos \alpha_1}{C_2} = \frac{40 \times 0.9563}{40.3113} = 0.9489$$

Whence $\alpha_2 = 18° - 24'$ and $\text{inv}\,\alpha_2 = 0.011515$
$\text{inv}\,\alpha_1 = 0.009025$

Solving equation (52), we have:

$$G + g = 40 - 2.4000 + 1.6354\left[80\left(\frac{3.1416}{80} + 0.011515 - 0.009025\right) - 3.1416\right]$$

$$G + g = 37.9258 \text{ in.}$$

With a center distance of 40.3113 in., the distance between the root radii will be 40.3113 — 37.9258 = 2.3855 in. This distance includes the working depth plus two clearances. With a clearance of one-tenth the working depth, we have:

$$1.200 \times \text{working depth} = 2.3855 \text{ in.}$$
$$\text{working depth} = 1.9879 \text{ in.}$$
$$\text{clearance} = 0.1988 \text{ in.}$$
$$\text{tooth depth} = 2.1867 \text{ in.}$$

Referring again to Table XIV of proportional center distance gears in the preceding article, we find that the outside radius of a 30-tooth gear that is to mesh with a gear of 40 teeth or more is 16.2000 in. We will use this same outside radius for this special gear, as the smaller of a pair always has the most sensitive tooth profile so that it is safest to make any necessary variation on the larger gear. The corresponding root radius is 14.0133 in. for the 30-tooth gear. Subtracting this from the sum of the root radii, we obtain 23.9125 in.

Table XV—Outside and Root Radii of Small Pinions Meshing with Gears of the 22½-Deg. Basic Rack, Proportional Center Distance System

No. of Teeth in Gear		Number of Teeth in Pinion				
		5	6	7	8	9
Outside Radius.	Pin-	3.8600	4.3650	4.7950	5.2250	5.6550
Root Radius. . .	ion	1.9350	2.3650	2.7950	3.2250	3.6550
Outside Radius.	15					8.1450
Root Radius. . .						6.1450
Outside Radius.	16				8.5750	8.6450
Root Radius. . .					6.5750	6.6450
Outside Radius.	17			9.0050	9.0750	9.1450
Root Radius. .				7.0050	7.0750	7.1450
Outside Radius.	18		9.4350	9.5050	9.5750	9.6450
Root Radius. . .			7.4350	7.5050	7.5750	7.6450
Outside Radius.	19	9.8650	9.9350	10.0050	10.0750	10.1450
Root Radius. . .		7.8650	7.9350	8.0050	8.0750	8.1450
Outside Radius.	20	10.3650	10.4350	10.5050	10.5750	10.6450
Roor Radius. . .		8.3650	8.4350	8.5050	8.5750	8.6450
Outside Radius.	21	10.8650	10.9350	11.0050	11.0750	11.1450
Roor Radius. . .		8.8650	8.9350	9.0050	9.0750	9.1450
Outside Radius.	22	11.3650	11.4350	11.5050	11.5750	11.6450
Root Radius. . .		9.3650	9.4350	9.5050	9.5750	9.6450
Outside Radius.	23	11.8650	11.9350	12.0050	12.0750	12.1450
Root Radius. . .		9.8650	9.9350	10.0050	10.0750	10.1450
Outside Radius.	24	12.3650	12.4350	12.5050	12.5750	12.6450
Root Radius. . .		10.3650	10.4350	10.5050	10.5750	10.6450
Outside Radius.	25	12.8650	12.9350	13.0050	13.0750	13.1450
Root Radius. . .		10.8650	10.9350	11.0050	11.0750	11.1450
Outside Radius.	26	13.3650	13.4350	13.5050	13.5750	13.6450
Root Radius. . .		11.3650	11.4350	11.5050	11.5750	11.6450
Outside Radius.	27	13.8650	13.9350	14.0050	14.0750	14.1450
Root Radius. . .		11.8650	11.9350	12.0050	12.0750	12.1450
Outside Radius.	28	14.3650	14.4350	14.5050	14.5750	14.6450
Root Radius. . .		12.3650	12.4350	12.5050	12.5750	12.6450
Outside Radius.	29	14.8650	14.9350	15.0050	15.0750	15.1450
Root Radius. . .		12.8560	12.9350	13.0050	13.0750	13.1450
Outside Radius.	30	15.3650	15.4350	15.5050	15.5750	15.6450
Root Radius. . .		13.3650	13.4350	13.5050	13.5750	13.6450
Outside Radius.	31	15.8650	15.9350	16.0050	16.0750	16.1450
Root Radius. . .		13.8650	13.9350	14.0050	14.0750	14.1450
Outside Radius.	32	16.3650	16.4350	16.5050	16.5750	16.6450
Root Radius. . .		14.3650	14.4350	14.5050	14.5750	14.6450
Outside Radius.	33	16.8650	16.9350	17.0050	17.0750	17.1450
Root Radius. . .		14.8650	14.9350	15.0050	15.0750	15.1450
Outside Radius.	34	17.3650	17.4350	17.5050	17.5750	17.6450
Root Radius. . .		15.3650	15.4350	15.5050	15.5750	15.6450
Outside Radius.	35	17.8650	17.9350	18.0050	18.0750	18.1450
Root Radius. . .		15.8650	15.9350	16.0050	16.0750	16.1450

Tooth depth = 2.0000 in. Working depth = 1.8000 in.

for the root radius of the 50-tooth gear. Thus we have the following values for this pair of gears:

	1 D. P.		10 D. P.	
	Pinion	Gear	Pinion	Gear
Number of teeth	30	50	30	50
Outside radius, in.	16.2000	26.0992	1.6200	2.6099
Root radius, in.	14.0133	23.9125	1.4013	2.3912
Tooth depth, in.	2.1867		0.2187	
Center distance, in.	40.3113		4.0311	
Pressure angle of cutter	17 deg.			

With the equations given in the seventh and eighth articles, and the many examples given there and in these last few articles, sufficient information is available to enable any pair or train of gears to be calculated, so that further examples should be unnecessary.

The smallest pinion considered thus far is one with ten teeth. Smaller pinions can be made, but they have been purposely omitted from all previous discussion because they should not be generally used for the transmission of power. Exceptional conditions are met occasionally where the use of smaller pinions seems advisable. We shall therefore give these smaller pinions consideration at this time.

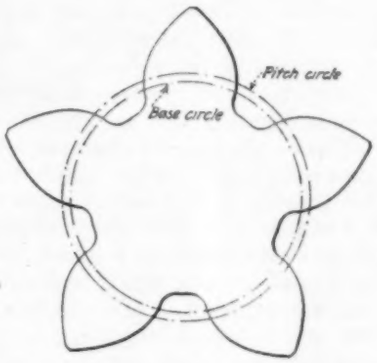


Fig. 81—Modified 5-tooth pinion

Theoretically, the smallest involute spur pinion that can be made with symmetrical teeth and give an overlap, or contact of one tooth interval or more, is one with 5 teeth. We will therefore direct our attention to a 5-tooth pinion.

When the numbers of teeth in the gears are small, the duration of contact is the limiting factor. In order to secure a line of action of sufficient length, relatively high pressure angles must be used, because the greater the pressure angle, the smaller the base circle, the longer the length of the common tangent, and the shorter is the length of the normal pitch. Extra length of contact is secured at the expense of sensitive tooth profiles and excessive sliding conditions.

The fewer the number of teeth in a gear, the greater is the care required to select the most favorable pressure angle and tooth proportions to secure sufficient contact without losing almost every valuable property of the involute curve.

In order to obtain any appreciable contact on a 5-tooth pinion, it is necessary to use its involute profile practically to the base circle. This means a very sensitive and troublesome tooth profile. Furthermore, the depth of the tooth on such a pinion is limited because it soon comes to a point at the tip. Although it is possible theoretically to make a pair of 5-tooth pinions that will mesh together with an overlap on the contact, to accomplish this would require the use of special cutters with a very high pressure angle. We will not attempt this, but will consider a 5-tooth pinion that is generated with a 22½-deg. cutter. This cutter has a working depth of 1.8000 in. and a clearance of 0.2000 in. We will make the root radius close to the undercut limit, and if the

Table XVI—Contact in Terms of Tooth Intervals Between Small Pinions and Gears of the 22½-Deg. Basic Rack, Proportional Center Distance System

No. of Teeth in Gear	Number of Teeth in Pinion				
	5	6	7	8	9
15					1.213
16				1.188	1.216
17			1.156	1.191	1.219
18		1.115	1.158	1.194	1.222
19	1.035	1.117	1.160	1.196	1.225
20	1.036	1.119	1.161	1.198	1.228
21	1.037	1.120	1.163	1.200	1.231
22	1.038	1.122	1.165	1.202	1.233
23	1.039	1.123	1.167	1.204	1.236
24	1.039	1.124	1.169	1.206	1.239
25	1.040	1.125	1.170	1.208	1.241
26	1.041	1.126	1.172	1.210	1.243
27	1.042	1.127	1.173	1.212	1.245
28	1.042	1.128	1.174	1.214	1.247
29	1.043	1.129	1.175	1.215	1.249
30	1.044	1.130	1.176	1.216	1.251
31	1.044	1.130	1.177	1.218	1.253
32	1.045	1.131	1.178	1.219	1.255
33	1.045	1.132	1.179	1.220	1.256
34	1.046	1.132	1.180	1.221	1.257
35	1.046	1.133	1.180	1.222	1.258
36	1.047	1.134	1.181	1.223	1.259
37	1.047	1.134	1.182	1.224	1.260
38	1.048	1.135	1.182	1.225	1.261
39	1.048	1.135	1.183	1.225	1.262
40	1.049	1.136	1.184	1.226	1.263
Rack	1.064	1.157	1.212	1.264	1.312

tip of the tooth becomes pointed, we will reduce its outside radius until this tip is at least 0.1000 in. on a pinion of 1 D. P. Thus we have the following:

R = 2.5000 in. = pitch radius at 22½-deg. pitch line
a = 22°—30′ = pressure angle of cutter
F = 1.2000 in. = addendum of cutter including clearance
f = 0.2000 in. = clearance
a = radius of base circle
A = undercut limit.

$$a = R \cos a = 2.3097 \text{ in.}$$
$$A = R \cos^2 a - f = 1.9339 \text{ in.}$$

We will round off this undercut limit to 1.9350 in. for the root radius, whence

H = 1.9350 in. = root radius
T_1 = 2.0140 in. = thickness of tooth on 22½-deg. pitch line.

With a tooth depth of 2.0000 in., the outside radius of this pinion would be 3.9350 in. We will first check the thickness of the tooth at this radius. From the seventh article, we have

$$\cos a_2 = \frac{r_1 \cos a_1}{r_2} \qquad \text{[Equation (39)]}$$

$$T_2 = 2r_2 \left(\frac{T_1}{2r_1} + \text{inv}\, a_1 - \text{inv}\, a_2 \right) \qquad \text{[Equation (40)]}$$

In this example:

a_1 = 22° — 30′
r_1 = 2.5000 in.
r_2 = 3.9350 in.
T_1 = 2.0140 in.

Whence $\cos a_2 = 0.58696$ $a_2 = 54° - 4'$ $\text{inv}\, a_2 = 0.43606$
$\text{inv}\, a_1 = 0.02151$ and $T_2 = -0.0925$

Hence this tip becomes pointed before it reaches the specified outside radius. We will therefore reduce this outside radius to 3.8600 in. and obtain the following conditions:

$r_2 = 3.8600$ in. $\cos a_2 = 0.59836$ $a_2 = 53° - 15'$
$\text{inv}\, a_2 = 0.40982$ and $T_2 = 0.1119$ in.

We now have the following values for the 5-tooth pinion:

$E_1 = 3.8600$ in. = outside radius
$R_1 = 2.5000$ in. = 22½-deg. pitch radius
$a_1 = 2.3097$ in. = radius of base circle
$H_1 = 1.9350$ in. = root radius.

The correction, or increase in the root radius of this pinion is equal to 0.5350 in. The smallest gear that can have a corresponding decrease in the root radius

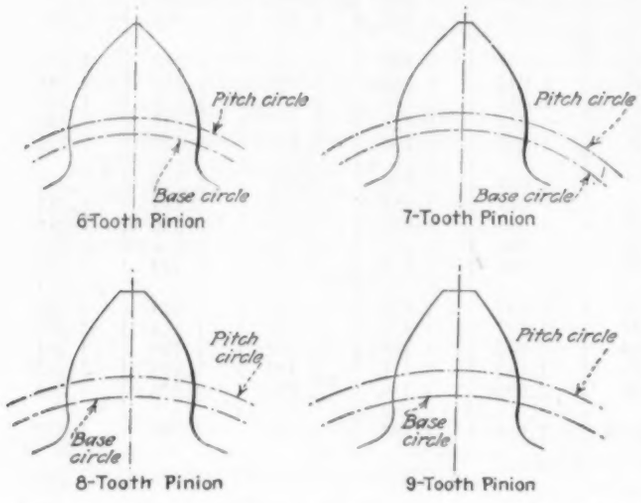


Fig. 82—Tooth forms of 6-, 7-, 8- and 9-tooth pinions

without undercutting is one with 19 teeth. This gear, to run with the 5-tooth pinion on a proportional center distance would have the following values:

$E_2 = 9.8650$ in.
$R_2 = 9.5000$ in.
$H_2 = 7.8650$ in.
$a_2 = 8.7769$ in.
$C = 12.0000$ in.

The contact between this pair of gears would be as follows:

$\sqrt{E_1^2 - a_1^2} = 3.0927$
$\sqrt{E_2^2 - a_2^2} = 4.5038$
$C \sin a = 4.5922$
$Pn = 2.9025$ in.
Contact = 1.035 tooth intervals.

The sliding conditions would be as follows:

Number of teeth	5	19
Max. radius of curvature of active profile	3.0927 in.	4.5038 in.
Min. radius of curvature of active profile	0.0884 in.	1.4995 in.
Specific sliding, addendum	+ 0.87	+0.92
Specific sliding, dedendum	−12.40	−6.83

It will be seen from the foregoing that the tooth profiles on such small pinions are of necessity very sensitive. In Fig. 81 this pinion is shown.

In a similar manner, values for other small pinions of 6, 7, 8, and 9 teeth have been established. These are tabulated in the accompanying Table XV. Contact conditions in terms of tooth intervals for these small pinions are also given in Table XVI. Fig. 82 shows the forms of the teeth of the 6-, 7-, 8-, and 9-tooth pinions.

These pinions are suitable for use as motor starting pinions, and for drives where minimum size is the controlling factor. They should be used only to meet extreme conditions.

Seen and Heard

By John R. Godfrey

About Modern Planers

IT'S very easy to get a notion for or against a certain machine or method, and the first thing we know it has become so fixed that we think it's a law, like gravity. In most cases it isn't anything of the sort. And some day, after we've lustily expounded our great discovery, some quiet chap in the crowd makes us feel foolish by showing that we are all wrong.

Just take planing for example. The casual observer in automobile and similar plants might easily get the notion that the planer was as extinct as the dodo. If he gets a chance to go into the toolroom of the same large plant, however, he'll see a bunch of planers. One toolroom I know of has nearly a hundred of *one make* of planer, besides a lot of other makes.

The same casual observer doesn't appreciate the change that has taken place in planers—to continue the same example. They still use a single-point tool on most work and move the table past the tool. It isn't easy to believe that the new type of planers can cut the time in two on an average job. Not by increased cutting speeds and cannon-ball quick returns—we exploded that notion years ago—but largely by putting power feed at a good rate, by the application of power for moving the rail and heads, and to operate the clamps to lock them in place, without an armful of wrenches and other conveniences too numerous to mention.

One of my good planing friends says his men can save 50 per cent in time on the average job that comes in by using one of the newest and best planers in the shop. He had a job the other day that was entirely new to his man, so he had to use his head as we went along. When my friend put in a bill for 8 hr. on the job, the customer couldn't believe it, because he'd been paying for 30 hr. on the same job in a shop with an old planer.

It's quite probable that a good part of this saving goes to the credit of the man on the job. But he couldn't do it without a planer having all the conveniences that save him tiring himself out moving heavy rails and heads, and the knowledge that the work would be accurate when he set the tool at the right place.

If modern planers can save half the time used by older machines, we needn't worry about their being pushed off the machine-shop map for some years to come. Just because we do milling and grinding where we used to plane on some work, doesn't mean the modern planer hasn't still a place in the sun. But it's a great mistake to try and use a planer when a milling machine or grinder will do that particular job to better advantage. And good planer men don't try.

Automotive Production

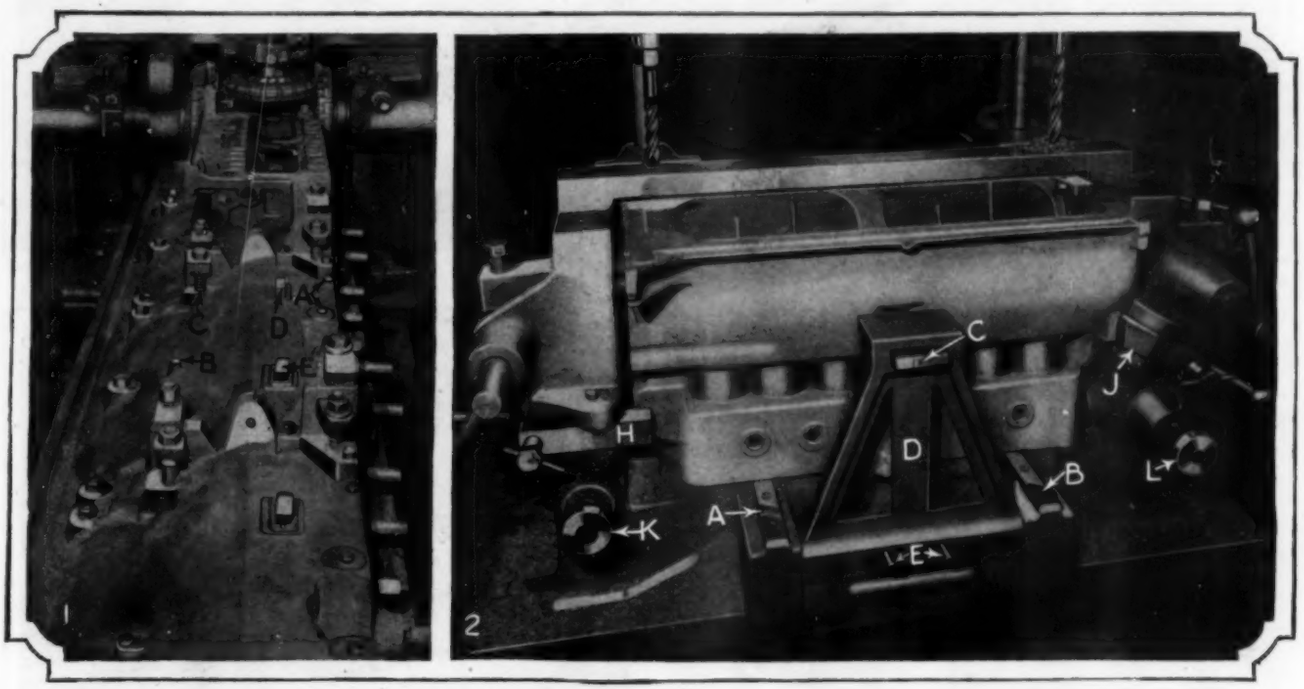


Fig. 1—Milling small cylinder blocks. Fig. 2—Drilling the locating hole

How Production Methods Vary in Shops Building "Light Sixes"

By Fred H. Colvin
Editor, *American Machinist*

Tools and fixtures for Cleveland "Six" cylinder blocks embody unusual features — Combined strap and cam clamping—"Pull" boring bars equipped with flywheels

THE Cleveland Automobile Co. builds two sizes of six-cylinder engines, the larger with the cylinder block and crankcase separate, and the smaller with the combination block. Thus the methods for the two types of blocks can be compared and the difference the type makes in the design of fixtures and tools can be seen. In both cases the castings are sprayed with Duco after cleaning, so as to make them more agreeable to handle. The first operation on the combined block is to mill both ends and the side as in Fig. 1, on a large Ingersoll machine. The fixtures are somewhat unusual.

The second article. The third will appear in an early issue.

The cylinder blocks rest on the hardened steel plugs *A*, *B*, etc., some of them being adjustable to take care of inequalities in the castings. Plugs as at *C* locate the flanges and insure squareness in facing tops and bottoms. In addition to these plugs there are two centralizing wedges, *D* and *E*, in each fixture, that come up between the first and second, and fifth and sixth cylinder barrels, locating the blocks endwise. These wedges are adjustable, the knurled handles at the right being provided for all the adjustments.

Details of the fixture for milling the top, bottom and side of the large cylinder, which is a separate

Automotive Production

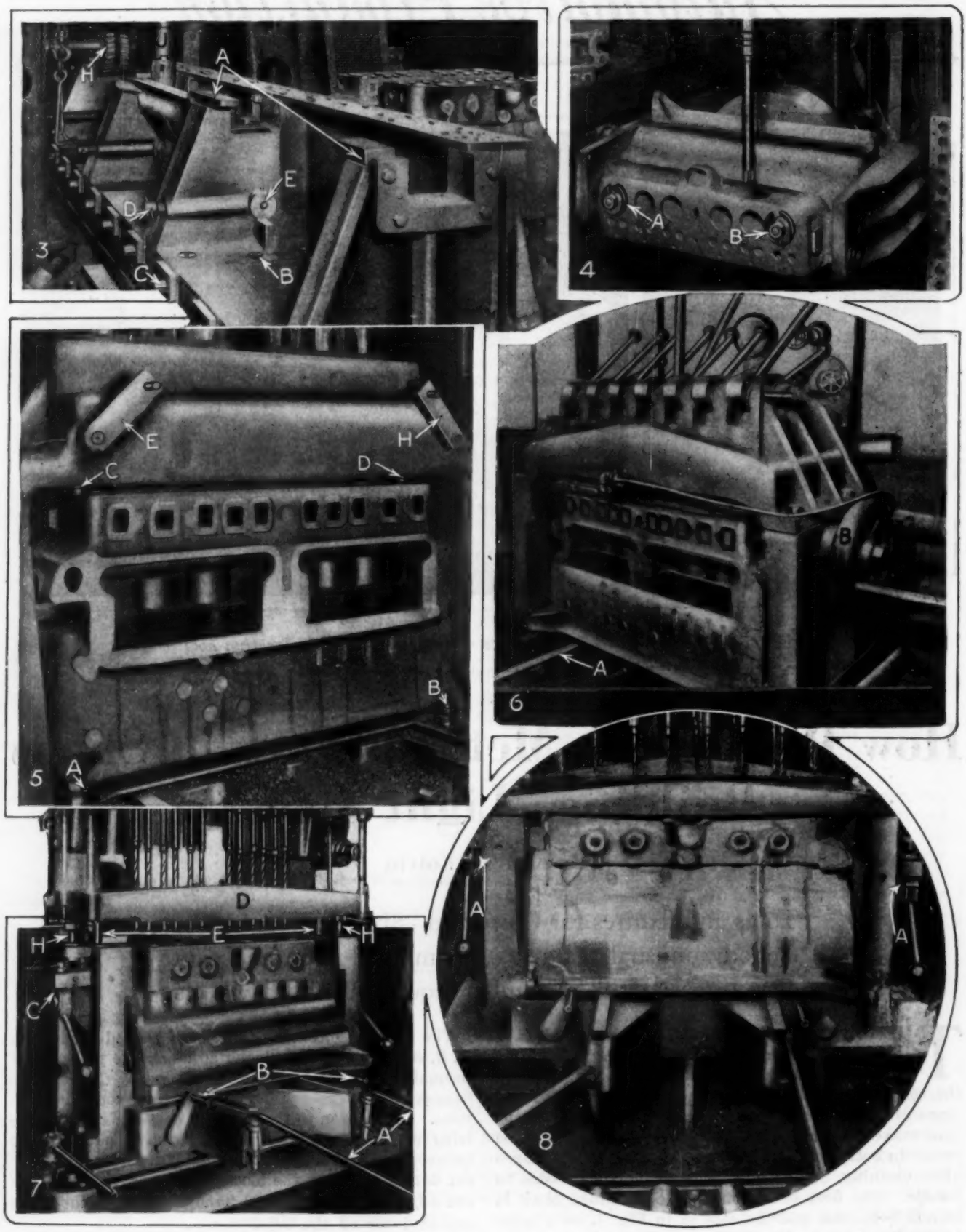


Fig. 3—Milling bearing-cap seats. Fig. 4—Counterboring for core-hole plugs. Fig. 5—Boring the cylinders Fig. 6—Fixture for water testing. Fig. 7—Drilling for valve-guide bushings. Fig. 8—Drilling for cover studs

Automotive Production

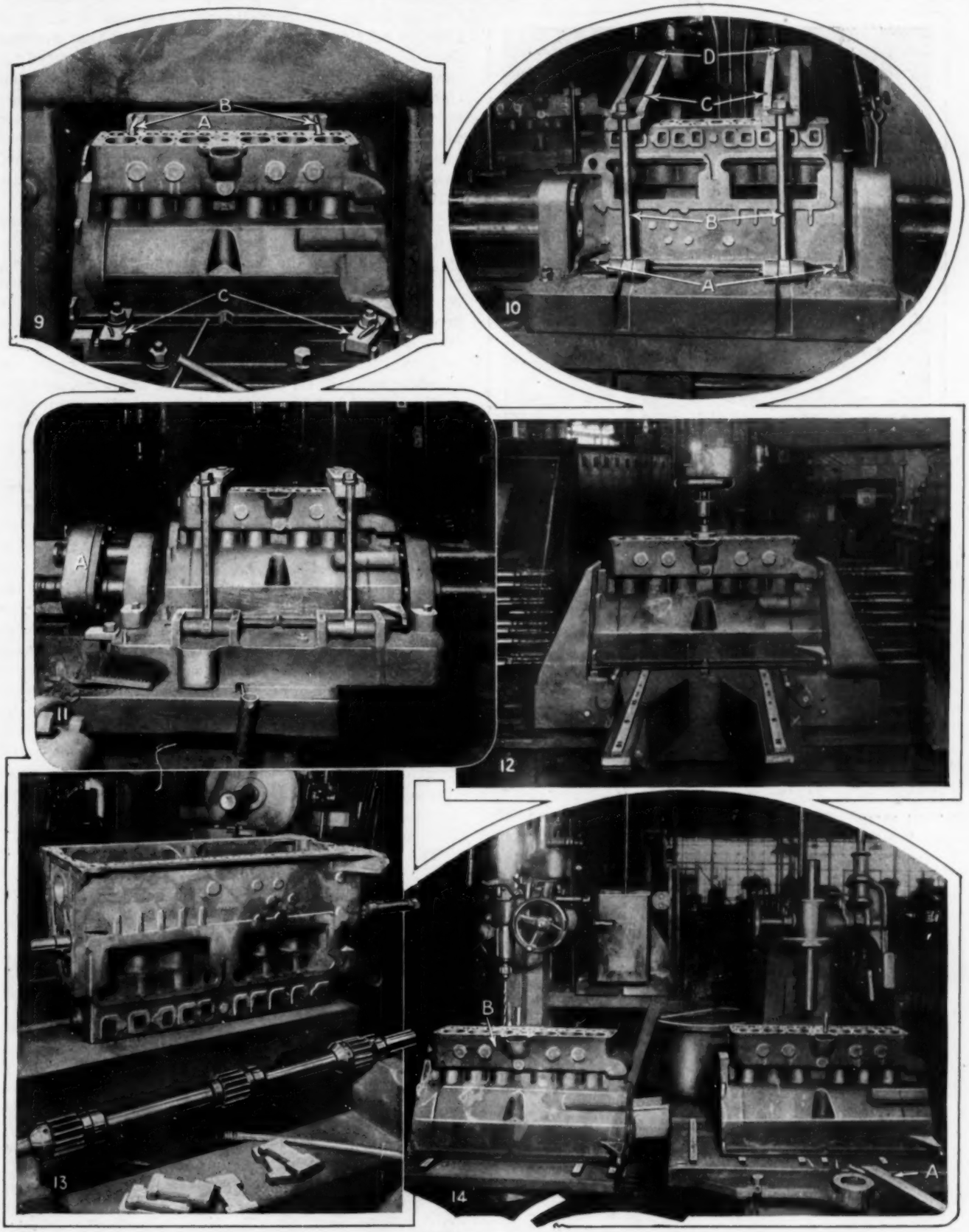


Fig. 9—Milling both ends of block. Fig. 10—Rough boring the shaft holes. Fig. 11—Finish boring fixtures and bar. Fig. 12—Drilling both ends at once. Fig. 13—Line-reaming shaft bearings. Fig. 14—Inserting and reaming valve guides.

Automotive Production

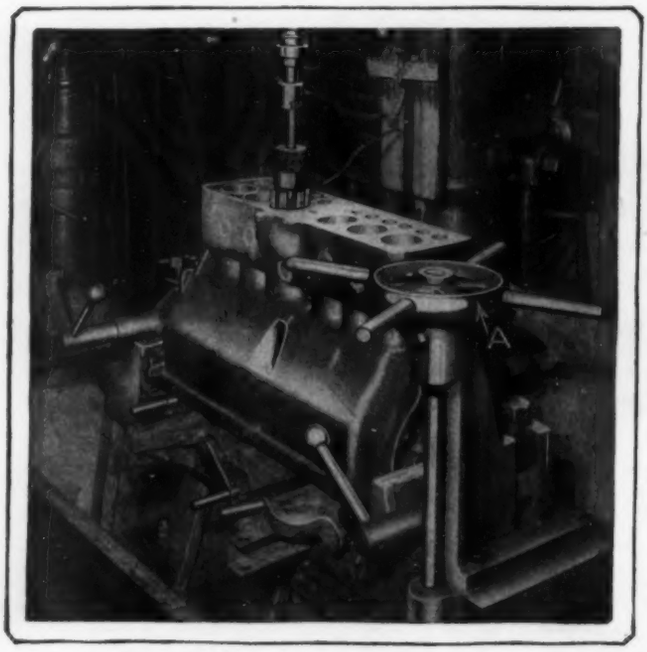


Fig. 17—Honing the cylinder bores

block, are shown in Fig. 18, and can be studied so as to require but little explanation. The blocks are aligned and supported by the block *A* and plungers *B*. They are positioned by the block *C* and the bell crank *D* which bear on the surfaces formed by the valve and push rod chamber. The plungers are operated by wedges as at *E*, while the bell crank *D* is operated by the screw *H* at the lower end. The ends of the cylinder block are clamped as at *J* between the block *K* and the strap *L*. The strap is double ended and clamps a block at each end.

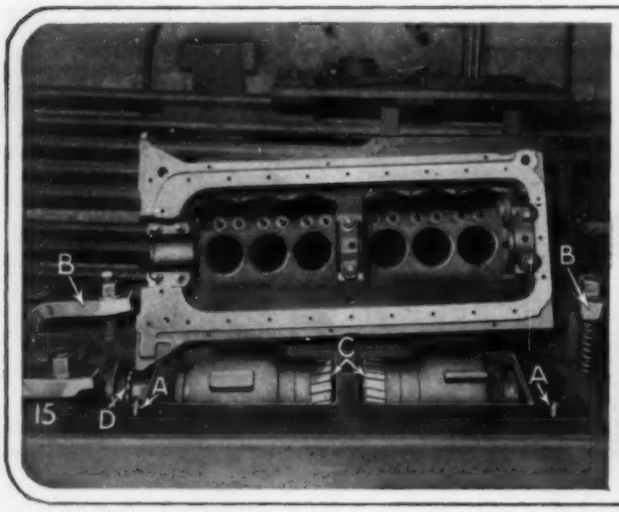
Two locating holes are next drilled in the flange in the fixture in Fig. 2. The top of the block rests on the steel strips *A* and *B*. The block is centered endwise by the wedge *C* in the frame or arm *D*, that can be swung down out of the way, and is locked in the position shown by sliding bolts, with handles at *E*. The block is held down by clamps at each end that bear in the shaft bearings. These end clamps are operated by cams under their outer end. In addition there are side clamps *H* and *J*, hinged in the fixture casting and operated by screws at the ends, while screws *K* and *L* lock plugs that go into core holes in the ends of the water jackets. With the case firmly positioned in the fixture, two good-sized locating holes are drilled in one flange at the points shown.

Locating by the holes just drilled the cylinder blocks are clamped in the fixtures in Fig. 3. The flange is forced up against the back strip and the straps *A* by plugs as at *B* in the bottom, the plugs being operated by the bolts *C*. End clamping is secured through the screw *D* and the plunger *E*. The bearing-cap seats are then both roughed and finished at one pass, using two sets of cutters. The roughing cut is taken by the straddle mills *H* on one side of the uprights, and the seats are finished by a cutter in the vertical spindle *J* on the other side. This method has been found very satisfactory, holding the cap seats to the required accuracy.

Machining for the welch plugs used in closing core holes, is done on the radial drilling machine in Fig. 4. The block is located in the swinging fixture by the two holes in the flange and is clamped through the cylinder holes as at *A* and *B*. The radial arm reaches all the holes on one side, after which the fixture is swung to bring the ends and the other side into position.

A close view of one side of the block is shown in Fig. 5, where the cylinders are being bored. The dowels through the large locating holes at *A* and *B*, and also the unusual feature of additional locating or steadying holes at the top, at *C* and *D*, can be seen. The upper dowels are operated by the levers *E* and *H*. It has been found that this method of holding prevents side movement or vibration of the upper end of the block under the action of the boring bars, and results in cylinder bores that are more accurate, and that require less allowance for the finishing operations.

The water-testing fixture, Fig. 6, is easily operated.



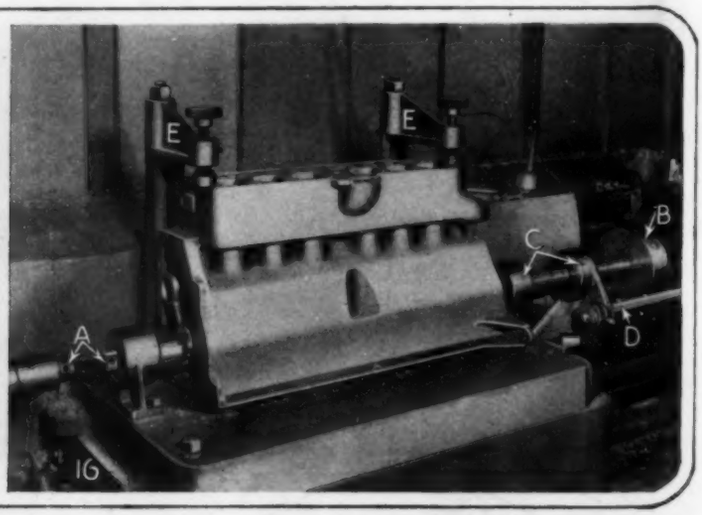


Fig. 15—Special milling fixture for facing center bearings. Fig. 16—Finish boring the shaft bushings

Automotive Production

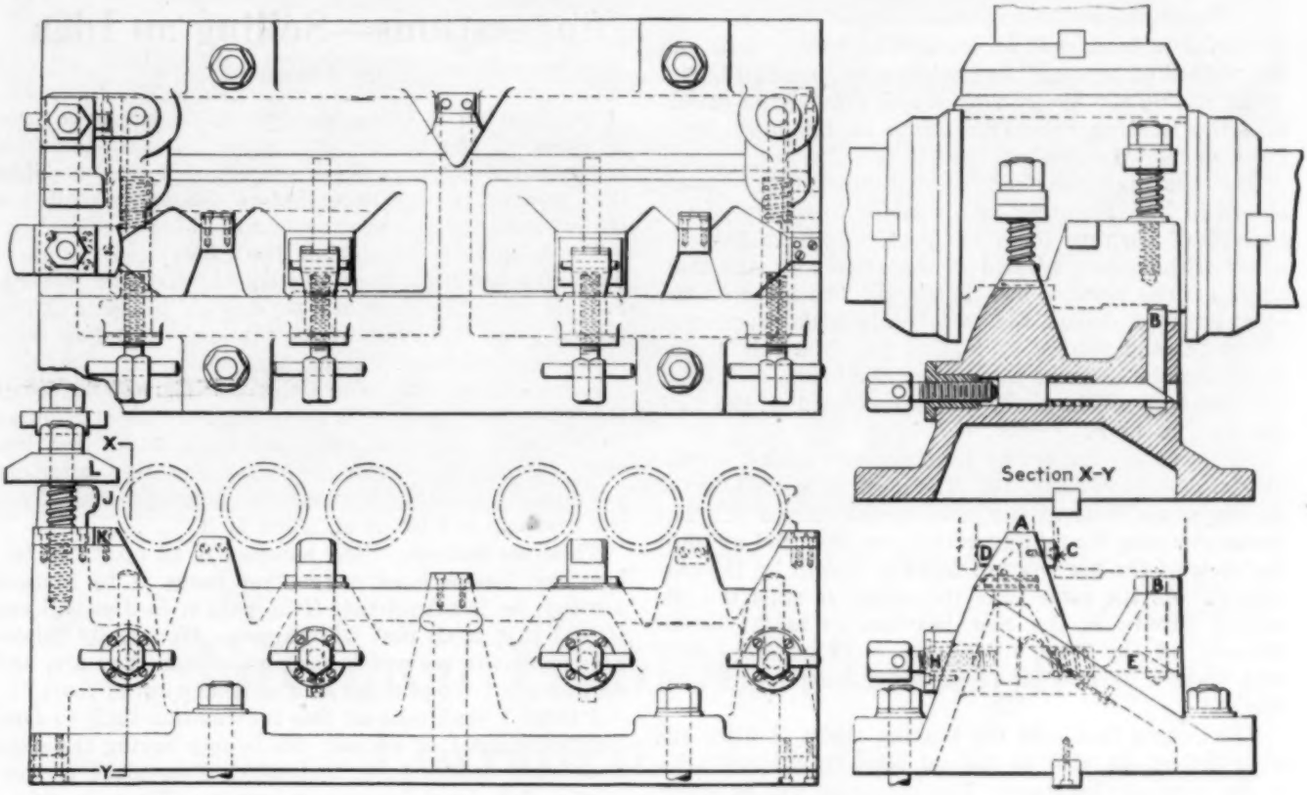


Fig. 18—Details of the milling fixture

The block slides in as at *A*, and a screw operated by the wheel *B* forces it to one side so that the end holes are closed. Then the heavy rubber pads at the top are forced down by the cams above, and the block is ready to have water pressure applied.

A Moline machine is used for drilling the valve-guide holes, as in Fig. 7. The cylinder block is slid from the conveyor line to the fixture on the rails *A*, which can be swung out of the way when not needed and so allow a free passage. The locating dowels are raised into position by the handles *B*, and eccentric clamps as at *C* hold the block down.

The bushing plate *D* is guided by the pillars *E*, and can be held out of contact by the stops *H*. It will be noted that the bushings extend through the plate far enough to bring them very close to the work.

A very similar fixture, Fig. 8, is used for drilling the stud holes in the top face of the cylinder block. This view shows the construction of the cam clamps more clearly. The small coil springs *A* open the clamp when the cams are released.

If, for any reason, a drill breaks or a drill spindle goes out of commission, the machine is not stopped unless the repair or change can be made very quickly. Instead of stopping the production line, the block goes on, minus a hole or two if necessary, to an emergency radial at a convenient point. This machine is provided with a light bushing plate, a duplicate of the one in Fig. 8, so far as bushings and spacings go. The plate is simply put on the top of the block, located by two plugs in the holes already drilled, and the missing holes drilled one at a time. Experience has proved this method to be a time-saver, and it is one that should be remembered.

The bottom holes are then drilled, the stud holes tapped, bearing studs driven, bearing caps put in place, valve-spring seats cut, and other minor operations performed, after which the ends of the block are milled as in Fig. 9. In addition to clamping the block by its lower flange, the head is tied against the angle plate *A* by means of the hook bolts *B*, that go into valve holes near the ends of the cylinder. The clamps at *C* are a little different from the ordinary practice, having screws with bent handles at the back ends of the straps.

The fixture in Fig. 10, in which both the crank- and camshaft-holes are bored, is a good example of fixture design. The locating dowels are at *A*. The clamping bolts *B* can be swung down out of the way and the heavy clamps *C* are counterweighted at *D*, making them easy to handle. The boring-bar bushings are carried in the heavy uprights at each end, and the bars are provided with wide, hardened steel strips, for guiding them.

Somewhat similar fixtures are used for the finish boring, as in Fig. 11, but the lighter work does not require the heavy clamping of the rough boring fixture. In the finish boring, the bars are pulled through the bores by the head *A*, both bars being driven from the same spindle. It is felt that there is less tendency for the bars to crowd to one side when they are pulled rather than pushed. Both roughing and finishing are done on Rockford machines.

Automotive Production

A double-ended Natco machine is used for drilling all the holes in both ends at once. The fixture used and the method of locating the block can be seen in Fig. 12. After sliding the block in place and raising the dowels into the locating holes, the clamp on top holds it in place during the drilling operation.

The bearings are line reamed with the reamers shown in Fig. 13, using an air motor to supply power, instead of turning them by hand. Both crank- and camshaft-holes are reamed in the same way, the camshaft reamer being shown in place. The holes on the sides are next drilled, the valve-guide bushings pressed into place and reamed as in Fig. 14. The rail *A* aids in sliding the block in place under the press, and, after the bushings are in place, they are reamed on the next machine, as at *B*.

The ends of the center bearings are milled on the special machine in Fig. 15. The block is located by the dowels *A* and held at the ends by the clamps *B*. The heads carrying the milling cutters are then fed up until the ends of the bearing are faced to length by the cutters *C*. At the same time the cutter *D* mills the oil-slinger groove in the rear bearing, to catch the oil thrown off by the oil flange on the crankshaft and prevent surplus oil from the bearing escaping at the end.

The dowels that hold the bearing shells in place are then drilled, as well as the oil holes from the main- to the camshaft-bearings. This operation will be shown in connection with the large engine in another article. After the bearings are in place, they are line bored by a special boring bar on the machine shown in Fig. 16. Here again the "pull" principle is used, the connection being shown at *A*.

Two features of this device are the use of the flywheel *B* to insure a steady cut, and the way in which the cutters are guided through the bushings *C*. The flywheel has two half-round grooves across the periphery, that act as an index for guiding the boring bar. In withdrawing the boring bar the flywheel is turned until one of the grooves matches a pin in the guide bar *D*. With the bar in this position, the cutters will pass through the slots in *C*, and it cannot be withdrawn until it has been thus located. After the bar has been coupled at *A*, it is drawn forward just ahead of the position shown, when the flywheel is disengaged from the pin in the guide bar, and is free to revolve while the bearings are being bored. The clamps *E* can be swung out of the way as soon as the screws are released.

The cylinder bores are finished with a hone of the rigid type, as in Fig. 17. The cylinder block is rigid, being held in the fixture by cam-actuated clamps at each end, after being located by two dowel holes. The block is indexed from bore to bore, the fixture being moved by the pilot wheel *A*, acting through a pinion and rack at the lower end. This fixture has been very carefully designed for easy and rapid manipulation.

The hone runs about 300 r.p.m. and makes about 150 strokes per minute. The roughing hones are 90 grit and the finishing hones 120 grit. From 0.003 to 0.004 in. is removed in finishing the bores by this method, and a fine finish is obtained at a low cost per block.

Suggestions—Selling an Idea

By Entropy

JIM is trying to bring his shop up to date or a little ahead of the times. One thing he is trying is a suggestion box. Says all he gets out of it is some paper that was worth something before the party wrote on it, but that the depreciation is something terrible.

I met up with a bunch of Jim's best men the other day and asked them how the suggestion system worked. Sam B. was the first one to express himself. "The scheme is all O.K., but what's the use? A fellow puts in a suggestion and nothing happens."

Ralph M. agreed, "You got to give the boys something to make 'em want to make suggestions. Of course there are a few boys with fool suggestions that put them in, but there was no reason for Jim expecting anything of them. Why don't he hang up a reward for the best one and let us all shoot at it?"

Then the last one, Pete, summed it all up, "The fellow that has a good suggestion keeps it to himself anyway, he is afraid that if he puts it in Jim will use it, and that is all that will happen. He usually thinks his inventions are worth a lot more than they are, and he wants to try and make a lot of money out of them."

I think I shall take all this information back to Jim, omitting names, of course. He is only having the same experience others have, and which Pete sized up correctly. I doubt if Jim expects any very big suggestions to come out of the box, but he hoped for a lot of little things that would help to make the wheels go around smoother and faster. The owner, super and foremen are so busy, and so accustomed to things as they are, that they overlook a great many chances to improve, and in fact they do not always know how their workmen look at a great many things. They need what ought to go into the suggestion box.

When it is to everybody's interest to do a certain thing it ought to be easy to get it done. Some try giving prizes for the best suggestion, and it brings out the man who wants a few dollars, but the man who is well fixed lays back, and largely because as Sam says, suggestions are not adopted. I believe that the right thing to do is to act on all suggestions, and to acknowledge every one except those that are plainly foolish, and then tell the suggester why they are not adopted.

A great many ideas in this world have to be sold. Merely offering them is not enough. Some one has to get back of them and nurse them and fight for them, and that is what the suggester cannot do unless he knows what the opinion of the management is about them. I remember going into a meeting once where the hours of labor of a large group of people was to be settled. After considerable discussion each of us wrote his suggestion on a slip of paper and deposited it in a hat. Then they were sorted. With about thirty people voting there was no majority, only seven agreed on one plan. My suggestion was a lone one, the only one of its kind, and yet in the discussion I was able to show that each of the plans offered, except my own had defects. The idea, if left alone, would have died a prompt death, but by persistent fighting it won out.

Fig. 1—Ladies' Night of the Dayton Foremen's Club

Foremen Training Through Foremen's Clubs

By T. B. Fordham
President of the National Association of Foremen
Works Manager, Delco-Light Co.

The need for foremen's clubs in industry and in the community—Advantages to the foreman and to management—What has been accomplished in Ohio

FOREMEN training must not be confined to what information and experiences can be given a foreman within the factory walls. This is the usual conception but it is coming to be classed as only a part of a rounded education for the modern foreman. Psychology teaches us that every experience leaves its permanent impression on a man's mind and character and that the more unusual the setting or environment, the greater the impression.

Many factories have their foremen's meetings in the same office the men are so familiar with (or have unpleasant memories of) and take up the usual production and material shortage problems. The everyday locations and situations become commonplace and lose their power to wake a foreman up and to shake him out of a rut. It requires new places, new speakers, new foremen to meet, new factories to visit and a broader outlook on the whole meaning of industrial life, if a foreman is to look at his job as a profession.

Foremen crave recognition of their position in the industrial organization and desire to have the job of being a foreman classed as a profession. They know what it takes to be a real foreman and want others to recognize the requirements and give due honor to the man who can be a successful foreman during a number of years.

The formation of a factory foremen's club and the city-wide foremen's clubs provides the opportunity to the foreman to attain some of the above-mentioned desires. Membership in the club, which is limited to a man who has the responsible charge of the work of other men or women, gives a certain prestige to the position and makes it worth while to strive to be a foreman.

The usual city foremen's club meetings consist of a dinner at a reasonable price, followed by singing by the entire group, an educational talk on an industrial process or scientific fact, and the inspirational talk by the speaker of the evening. After this, a trip is taken through some factory to see what sort of place the other man works in and what products he makes. If possible, it is very desirable to have the meeting in the cafeteria of some industry so that no trouble will be had in taking the factory trip.

Why does this kind of a meeting have an attraction for foremen? It has all the elements of changed

environment and the stimulus of meeting new men and other foremen. The factory trip feature does two things: First it reacts very directly on the visiting foremen who see what a neat orderly department the other man keeps, and second, the foreman whose department will be visited aims to have his place in the best of condition. It is his place and he knows what comments his brother foremen will make if it is not what it should be.

Out of these factory trips, many new ideas are secured which are of direct monetary value to the other factory. In one case, in an Indiana city, a visiting industrial man saw a local company using glass in their product. He inquired where they secured it and found that it was bought at a distance. He returned home and reported to his executive that he thought his company could make the glass, and the salesman soon went out and got the contract so that the home industry benefited by this interchange of purchases.

What advantages do the Foremen's Clubs offer to the average foreman of our industries today?

1. An appreciation of the magnitude of the industrial life of his city and the United States.
2. The opportunity of getting new ideas of processes and operations from other foremen and through factory visits.
3. Inspiration gained from talks given by prominent speakers at regular monthly meetings.
4. Educational facts gained in the talks given by various speakers.
5. Knowledge of the many factors that enter into the job of being a modern foreman, such as—his own personal characteristics, how to handle men, factory systems and methods, and the need for efficient management of his department.
6. The public recognition of the foreman's job as a profession, which demands that he constantly strive to improve himself to be worthy of the title of foreman.

The advantages to Management in having Foremen's Clubs are:

1. The foremen of the small factory are able to enjoy all the advantages and contacts as do those of the largest industries, through the Foremen's Club activities.
2. The loyalty of each foreman is increased toward his own company because of his better knowledge of the proper relationship between materials, production, costs, profits, and stability of employment so much desired by management.
3. Increased capacity and self-confidence possessed by the foremen because of their participation in the club activities, working on committees, banquets, etc.
4. Benefits of new ideas gained by the foremen through meeting other foremen and the incentive to put their departments on a business-like basis.
5. Better industrial relations in the factory because of the improvement of the foreman's attitude toward the management and his broader viewpoint of the basic factors of industrial life.

The employee directly benefits by having a better and more agreeable foreman to work for. A great share of the emphasis in the inspirational addresses is upon the proper handling of men so that the factory becomes an agreeable place to work with justice and helpfulness freely given.

In many cities it is very evident that the co-operative spirit among the various industries is almost entirely lacking. This company spirit is passed down among the men and the loyalty to the city as a whole and to the company becomes only that which is given towards the source of the bread and butter necessaries

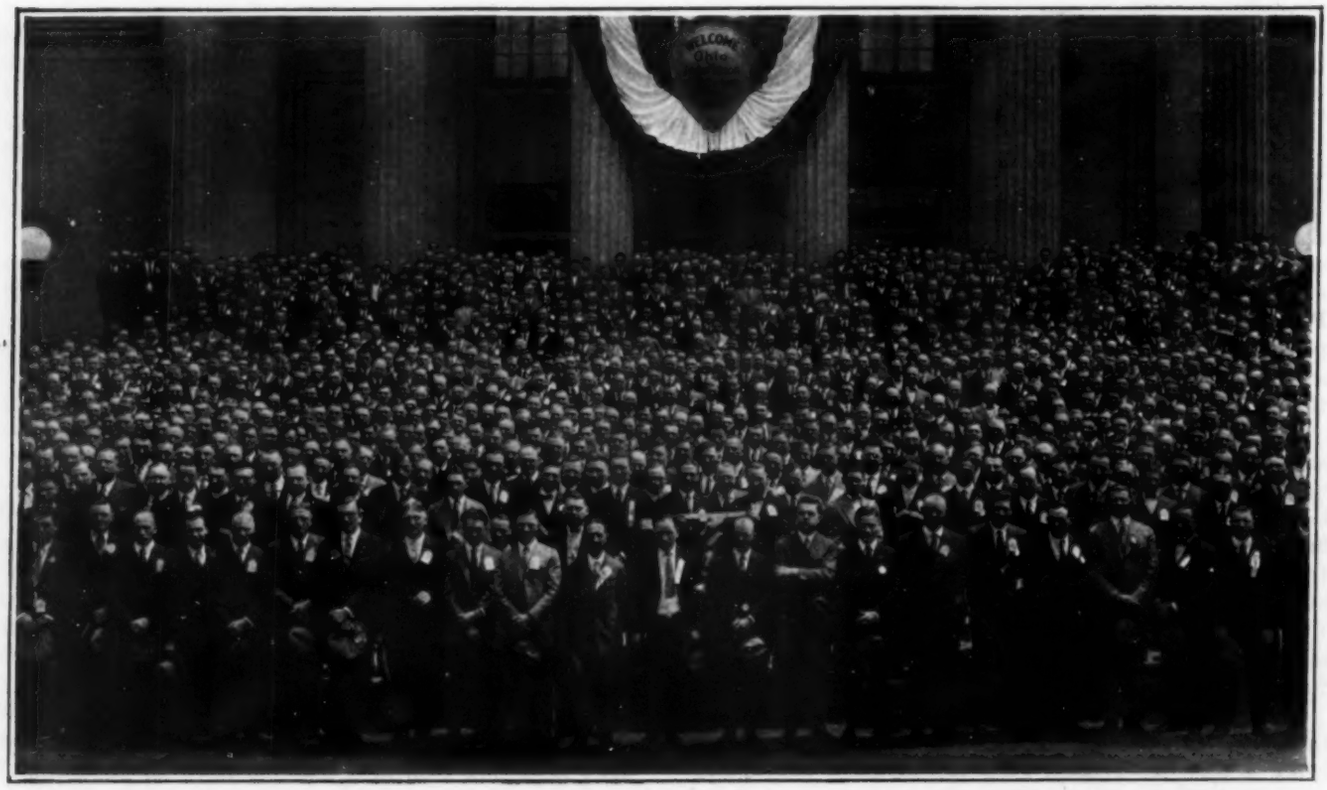


Fig. 2—Group of foremen at the first meeting of the Ohio Federation of Foremen's Clubs

of life. Communities that have the Foremen's Club in their industrial life find a marked change of attitude, not only among the foremen themselves, but among the workmen also. A recent case to illustrate this point. At an election in November, a bond issue for new schools and for improvements to existing schools was to be presented. The superintendent of schools obtained permission to address the local foremen's club and sold the necessity for this money to the six hundred fifty men present. The bond issue carried with a substantial majority because these foremen were able to give sound advice to their workmen when the subject was discussed. The same applies to the Red Cross and Community Chest collections which were properly understood by the foremen.

The Dayton Foremen's Club now numbers one thousand six hundred and sixty-five members, and according to a careful check-up on the two hundred thirty-five industries represented, these foremen actually influence over forty thousand working people. Assuming that each workman is the support of a family of four, this means a contact with over one hundred sixty thousand persons. What a powerful influence such a club can be if properly guided and supported by both the foremen and the management.

The success of the Foremen's Club must be credited somewhat to the recognition of the wife's interest in a man's job. It is well known that the status a man holds in industry, determines to a great extent the advantages which his family will have as regards education, social life, clothes, food, etc. It is therefore, always desirable to enlist the wives' interest in any program for encouraging the foremen to be more ambitious, and to strive to make good on their jobs. This is accomplished in several ways, but especially through having one meeting a year devoted to the ladies. At this meeting, a popular subject is chosen for the speaker and entertainment suitable to the occasion is presented. Fig. 1 shows the group on Ladies' Night of the Dayton Foremen's Club in March of this year.

In the summer a family picnic is always held at which time the various families get together for a day's outing and a splendid spirit of industrial cordiality and co-operation is developed. At Christmas time, Santa Claus takes charge of the December meeting, and again the family participates in the enjoyment of the season and the children are given presents. It is readily seen that a genuine tying together of the family, the foreman and the management is accomplished, which cannot but help in making any industrial community as a whole far better for having a Foremen's Club in its midst.

Any movement to be successful must have a program. Each individual Foremen's Club has a program of activities, which to them seems best suited to local conditions. What links this up with other groups of Foremen's Clubs working for the same end? It is rather easy for a local group to be satisfied with a program of entertainment and educational features which is easy for them to secure.

The founders of the National Association of Foremen saw the necessity of co-ordinating the work of the various established Foremen's Clubs so that these units would be coupled together into an association through which the programs could be guided, and new information and educational ideas could be circulated. The fundamentals back of the National Association of Foremen are basically sound and rest upon the desire to better industry and permit the foreman to improve his condition by rendering better service to the industry of which he is a part.

The object of the National Association of Foremen is: "To help in the promotion of better foremanship, by studying the needs and opportunities of industry in order to make each individual foreman a power for good in his own organization and community. To accomplish this, the Association will endeavor to promote:

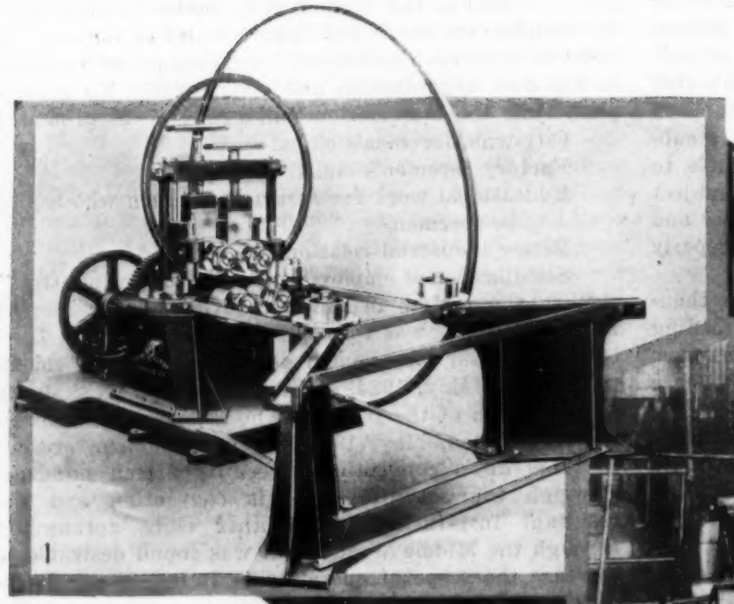
City-wide foremen's clubs
Factory foremen's clubs
Educational work for foremen and men who aspire to be foremen
Better industrial relations
Stabilization of employment and profit in industry."

With these aims in mind, the Ohio Federation of Foremen's Clubs was formed several years ago in Dayton, Ohio, and two annual conventions were held in that city, in May, 1924, and May, 1925. Fig. 2 shows a photograph of the foremen who attended the convention in Dayton, May, 1925, the total number present for this day's convention exceeding fifteen hundred. Through the activities of this convention and the resultant inspiration, many other clubs sprang up through the Middle West and it was found desirable to increase the scope of operation to include many Foremen's Clubs and factory clubs from any part of the United States. Therefore, the National Association of Foremen came into being on Oct. 8, 1925, and the membership today includes approximately five thousand foremen and superintendents from cities and states all over the country. The most prominent clubs affiliated are those in the cities of Dayton, Cincinnati, Toledo, Springfield, Lima, Canton, Piqua, Middletown, Portsmouth, and Salem, Ohio; and Richmond, India; Pontiac, Michigan; Kansas City, Missouri; and many other factory foremen's clubs.

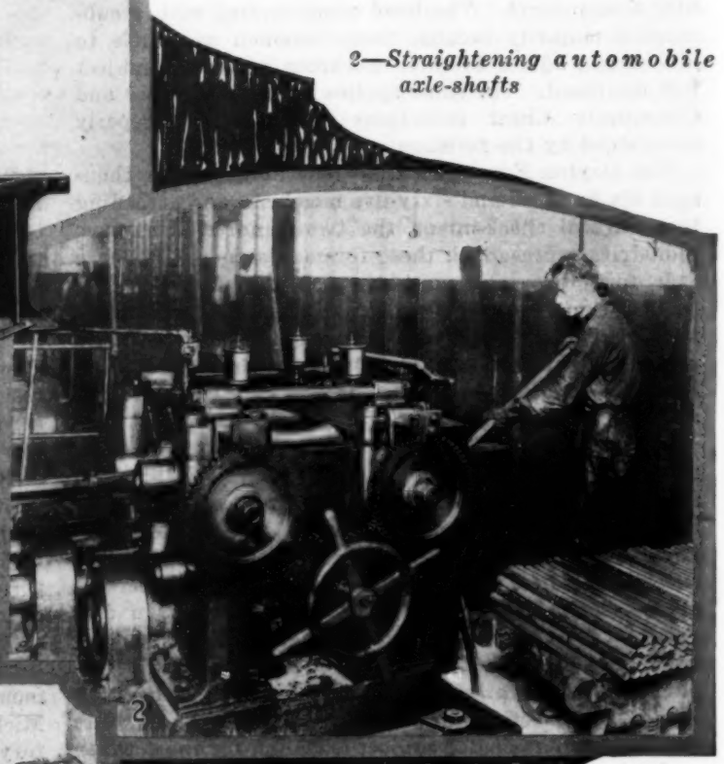
The attitude of the foreman toward the Foremen's Club is first one of interest and later one of keen appreciation and enjoyment of the programs presented and of the education and inspiration to be gained. The foremen feel that they would like to know the other fellow who is in the same type of position, and would like to associate with men of their own industrial standing. The average foreman, being a production man, enjoys getting results and therefore is able to work on committees and prepare programs and see them through to a successful finish. In many industries, the factory foremen's clubs are given the responsibility of helping on the convention programs, putting on exhibitions, and arranging for factory trips, etc. This gives the foreman the sales viewpoint and the necessity of understanding the customer's requirements and why a quality product is necessary. If the foreman is kept in the background, and the sales department takes the visiting salesman through the factory, a natural dissatisfaction is engendered and the foreman feels that it is useless to care what happens to his product after he finishes it.

In the past twenty-five years there has come into the industrial life of our country no single influence for good as great as that of the Foremen's Club movement. It is confidently believed that this organization has within it greater possibilities for preserving industrial harmony and the stability and profitable operation of industry than any method or attempt that has preceded it.

How Bars and Strips Are S

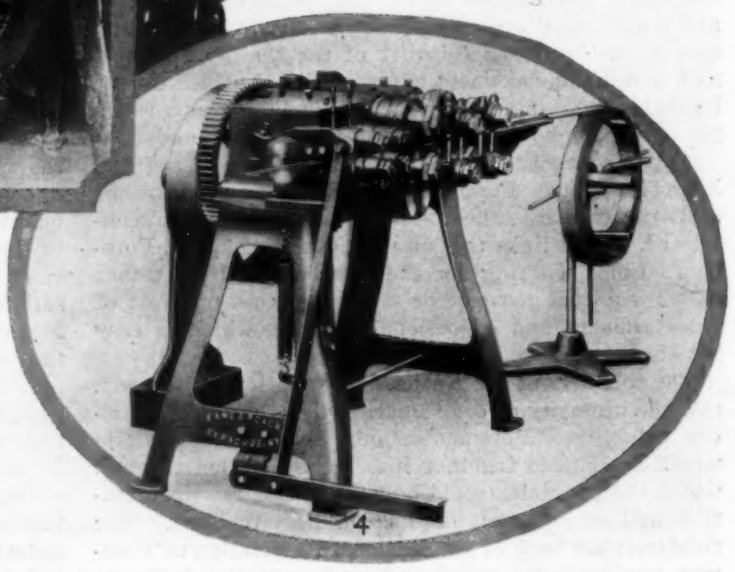


1—Bending heavy flats



2—Straightening automobile axle-shafts

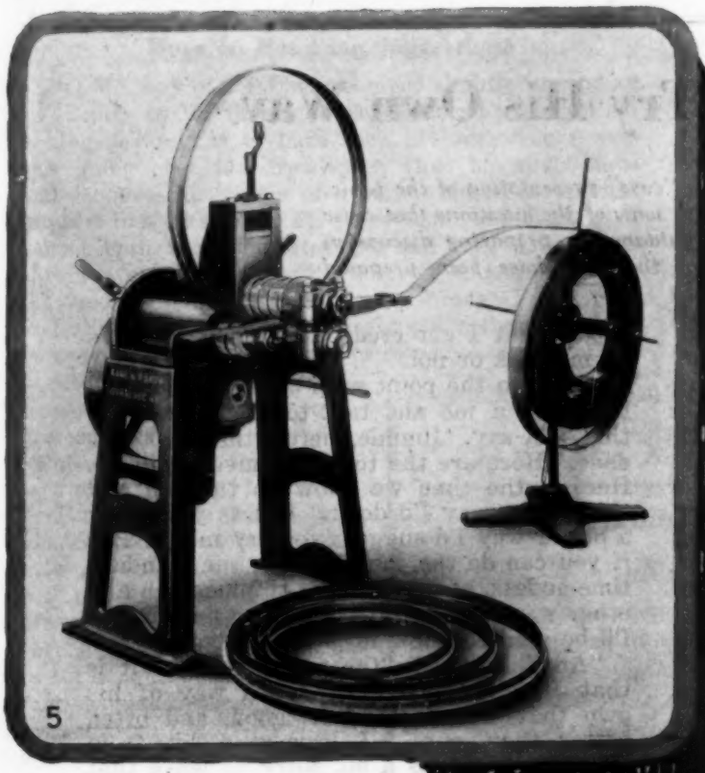
3—Forming and bending brake-band covers



4—Forming slats for radiator covers

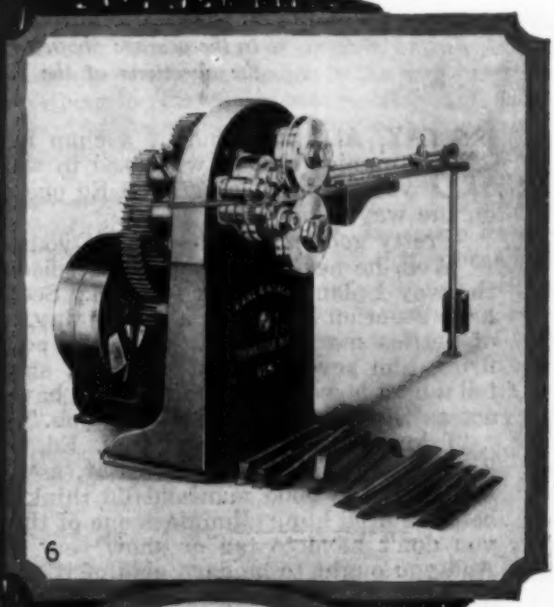
Photographs by courtesy of Kane & Roach, Syracuse, N. Y.

Straightened and Formed



5

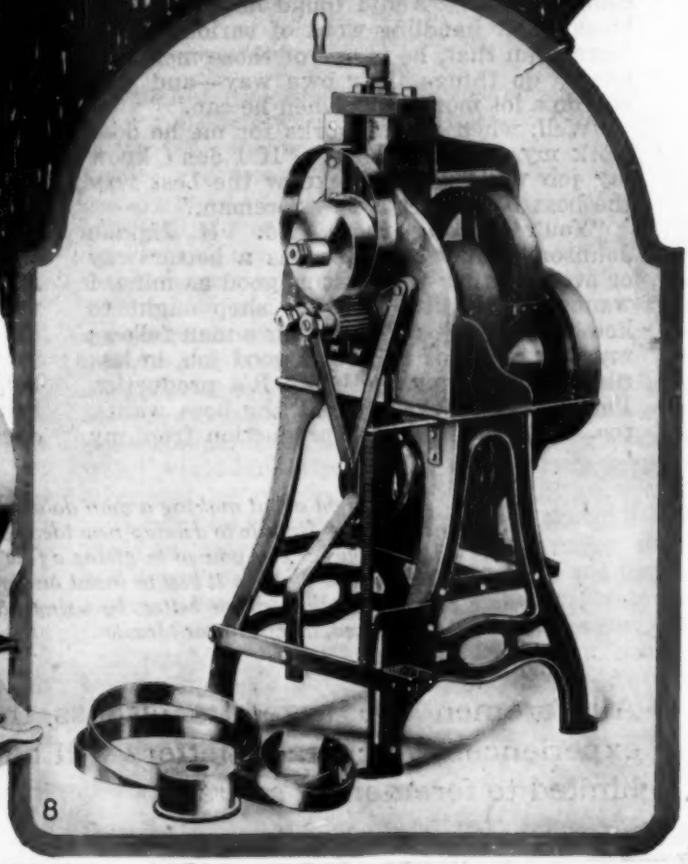
6—Forming reinforcements for metal furniture



6

5—Forming and bending rings for furnace casings. 7—Bending ring-gear blanks. 8—Bending automobile brake-bands

7



8

THE · FOREMAN'S · ROUND · TABLE

Letting a Man Try His Own Way

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

"SAY, Al, what kind of a chap is that Jimmie Johnson who used to work in your department?" said Ed one night on the way home.

"Pretty good man, Ed—why do you ask?"

"Well, he never seems quite satisfied with the way I plan out work for him. Seems to have a notion he knows a better way. Sort of nettles me 'til I've been on the point of firing him several times. After I show or tell a man how to do a job I hate to have him act as though I didn't know my job."

"I know Jimmie pretty well, Ed, and I know just what you mean. But, as I said before, he's a good man and I'd think twice before I fired him. Jimmie is one of the men you don't have to tell or show very much. And you ought to be darn glad of it.

"I had the same experience with Jimmie," continued Al. "And I found he was full of ideas about handling work of various kinds. More than that, he is one of those men who like t' do things their own way—and who will do a lot more work when he can."

"Well, when a man works for me he does work my way," said Ed. "If I don't know my job well enough to know the best way the boss better get a new foreman."

"You're wrong there, Ed. If Jimmie Johnson or any one else has a better way or even another way just as good as mine, I want to know it. And the shop ought to know it. I don't care whether a man follows my way or not if he does a good job, in less time than by my method. It's production I'm after, and that's what the boss wants, too. And when he gets production from my department I get credit for it whether it's all my idea or not.

"I got to the point with Jimmie where I'd take him a job and talk to him about like this—I'd say, 'Jimmie, here's the job to be done. Here are the tools we have available. Here is the time we allow on the job and this is the way I'd do it. Unless you know a better way I'd suggest you try mine. But if you can do the job right, in our standard time or less, and with this equipment, in any other way, go to it. If there's a better way I'll be glad to know it.'

"And," said Al, "the funny part of it is that Jimmie very often had a way of his own that was at least as good, and often better than ours. I learned a lot from Jimmie and I was a bit sorry to leave that department on that account. Wish I had one or two like him where I am now."

"That may be all right, Al, but I don't see how you keep discipline or authority when you let a man do as he likes. When I'm running a department I want to run it, and not have any man telling me he knows a better way."

"Ed, I don't think you put that just right. Our job is to run our departments so as to get the most production at the lowest cost. If one of our men has ideas that will help, it's up to us to get 'em. If we have a man with ideas who will be happier and will give us more ideas if we humor him a bit—it's up to us to humor him. Lastly, Ed, Jimmie helped me to be a better foreman, and he'll help you if you let him—even though he doesn't realize he is helping."

Is Ed right about making a man do work his way? Or was Al right in encouraging Jimmie to develop new ideas by letting him try his own methods? How far can you go in giving a free rein to the workman's personal ideas as to work? Is it best to insist on certain methods when a good man can do equally well, or better, by using his own method? Which should be sacrificed, discipline or ideas?

All foremen are urged to discuss these questions from their own experience. Acceptable letters will be paid for. The discussion is not limited to foremen. of course.

Discussion of Earlier Topics

More on Handling Suggestions

TO MY way of thinking, Al erred slightly in sending Scotty to Williams. It would have been more advantageous for Al to have been present when Scotty was going over the drawings. Thus he would have had complete knowledge of a matter that was of vital interest to a man under his supervision, and could have helped both the superintendent and the employee to obtain a clearer view of the other's opinion, through the medium of the foreman, who through direct contact with both, could more easily grasp their separate viewpoints and do something to reconcile them.

Although, in exceptional cases, it sometimes becomes necessary for the superintendent to have direct contact with the man, as a general thing it is hardly advisable as it is apt to give the man an exaggerated idea of his own importance, which often leads to trouble and discord. Another element that is apt to enter the field is the fact that other persons in the organization are likely to follow in the super's footsteps, so that in time the foreman is out of touch with many things happening in his own department.

In most of the shops of today personality is a big factor in the selection of the foremen, and one of the main attributes of the right personality is the ability to give credit where credit is due. Realizing this, it would hardly seem that a foreman who has been selected by the management to be the supervisor of a body of men would have cause to worry about being replaced by one of them.

—F. G. WILSON.

* * * *

How Should Suggestions Be Handled?

I BELIEVE Al was right in sending Scotty to Williams because it is always best for the one who has a new scheme to present it himself so that no points may be lost in passing it through a middleman.

Scotty did right in first presenting the matter to his foreman. This procedure should always be followed.

The old superintendent may have had some excuse for dealing with the foreman only in his time, and under conditions that may have formerly existed, but under present day conditions I believe Al's and Scotty's plan to be the best.

If Williams is in the superintendent's place because of merit—as he probably is—Al is in no danger of losing his job for such an act.

Scotty should feel that he has done only what he should as a part of his job, but the superintendent should show due recognition to Scotty in a substantial way commensurate with the gain effected. Al should have full knowledge of this, of course.

—JOHN MARK MAY.

* * * *

How Much Standby Equipment?

IN SHOP work, as in every other activity of life, experience has taught most of us that we can proceed more steadily and can get farther in the long run if we hold something in reserve for emergencies. This is the second wind of the runner, the factor of safety the engineer includes in his design.

In the machine shop, the wise foreman is not satisfied unless he has some reserve capacity, so that he can continue to produce if an accident should temporarily put some of his equipment out of commission.

He has probably seen, at some time in his experience, the results of a breakdown which entirely stopped the production of the parts the disabled machine had been making. He has seen the assembly floor idle, with the men laid off and the work piling up every day until it seemed hopeless to relieve the jam.

With this sad experience behind him the foreman never feels safe when his department is being pushed to its full capacity. He is like the old lady at the theatre who doesn't enjoy the show because she keeps one eye glued to the "Exit" sign. He always wants to know the way out.

In many plants it is not practicable to establish and maintain such an even balance between machines that each one is used all the time. This leaves a certain margin of unused capacity. Before increasing this idle machine time by adding standby equipment, careful consideration should be given to the possibility of using the extra capacity in case of a breakdown. It is often much cheaper to do a job on a less effective machine, which would otherwise be idle, than it is to keep another machine standing by.

The amount of reserve capacity a shop should have is based on the experience of that particular shop, which will depend on the kind of work it is doing and the age and condition of its equipment, as well as on the results that an interruption of production would occasion.

A small, and usually sufficient, amount of standby equipment, which in the last analysis means idle time of any equipment, is not expensive to maintain. As the amount of idle time increases, however, its cost mounts very rapidly. The danger of getting out of the safe limits should be well understood. WALTER A. WOOD

THE · NEXT · TOPIC

Keeping Machines on the Job

QUESTIONS

Who should be responsible for keeping machine tools in repair?

If there is a machine repair foreman, where should his authority end and that of the department foreman begin?

Which is the better policy, to maintain machine equipment or drive it until it fails?

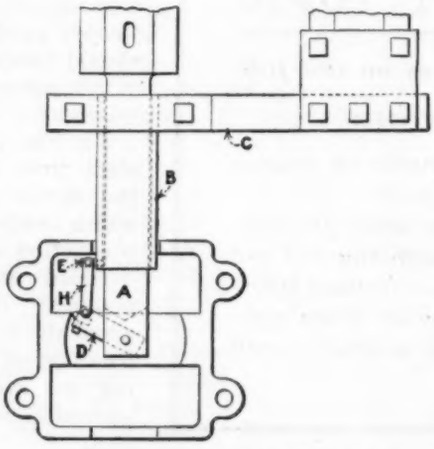
Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Boring Spherical Seats

BY V. A. HERMANN

We had a quantity of shaft hangers in which the seats for the boxes were to be bored to a spherical shape. The work was done in a double-head, vertical boring mill with tools arranged as shown in the illustration. The boring bar *A* was held in the left-hand head and passed through the sleeve *B*, held in the right-hand head by a clamp bar as at *C*. The tool was held in the swinging bar *D*, which was pivoted to the boring bar and connected to a lug on the sleeve at *E* by the bar *H*. In operation, the boring bar was held stationary and the feeding was done by the right-hand head. Since the sleeve was clamped to this head, it moved up or down in unison with the head, causing the bar *D* to describe an arc.



Tools for spherical boring

Preventing the Breakage of Small Oil Stones

BY CHARLES DOESCHER

Small oil stones are easily broken, particularly when they are used for honing a die having an opening of irregular shape.

One reason for breakage is when the stone is too large, it is liable to get caught in some part of the die opening, requiring considerable force to remove it. One way to prevent the stone from being broken under such conditions, is to reduce its size so that it will be smaller than the smallest part of the die opening. The reduction can be made by grinding it on an abrasive wheel.

Another common reason for a broken oil stone is that the user bears too hard on it. If a small oil stone is forced, it will be sure to break.

One of the chief causes for broken oil stones is in honing dies held in a vise. The tendency of the user is to draw the stone too far on the backward stroke, with the result that the stone will slip out of the die opening and come down on the vise jaw with force enough to break it.

To prevent an accident of this kind, the die should be held in parallel clamps, which in turn should be held in the vise, so that the die is at one side of the vise. This position of the die will not interfere with the honing, and if the stone slips out of the die opening on the back stroke, there will be nothing for it to strike.

Boring and Checking a Bell Housing

BY FRANK C. HUDSON

Although automobile shops have as a rule a large enough production to warrant fixtures that would cost more than the average small shop could afford, there are many ideas to be found that can be adopted, or modified, to suit the small shop. Such a fixture is shown in Fig. 1, while Fig. 2 has gaging features that are of special interest.

The bell-housing shown in the foreground in Fig. 1,

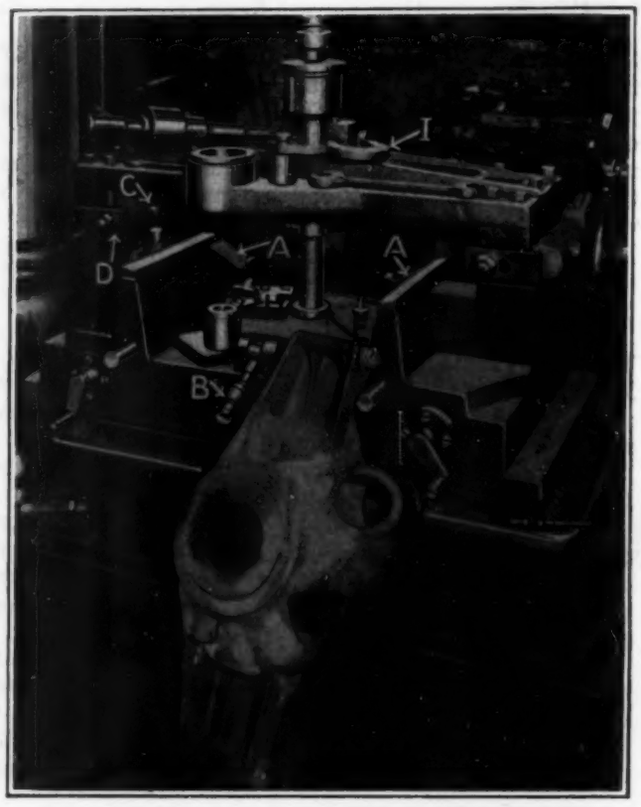


Fig. 1—Fixture for boring bell-housing

is awkward to handle since it is integral with the support arms for the engine which must square with the housing itself. The housing slips under the guide plate and is locked by swinging latches *A*, and is supported at the sides by screw jacks, as at *B*, that swing down when not wanted. Dowel *C* fits in a hole in the end of the arm, and the clamp *D* prevents end movement.

Guide bushings are provided for both the center hole and the starter hole, at *E* and *H*. The hook *I* is swung under the guide bushing for the central boring bar, to hold it while the arm of the radial is swung over to bore the starter hole.

The gage in Fig. 2 is a good example of checking the squareness and alignment of various surfaces. The

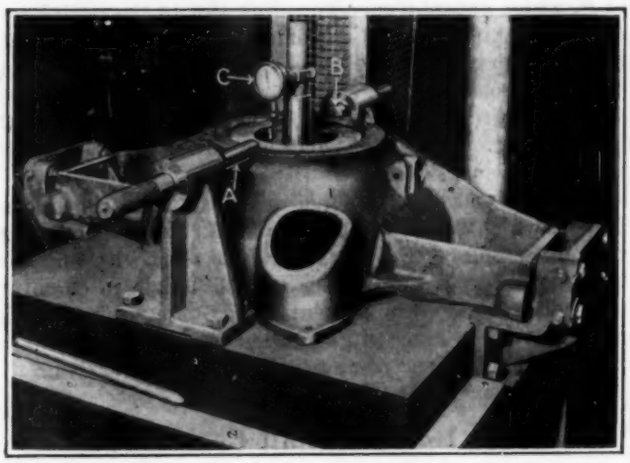


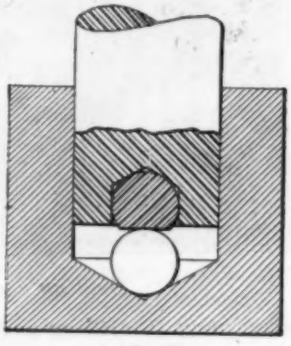
Fig. 2—Checking essential dimensions

large face of the housing rests on the base of the gaging fixture, and the support arms rest on the brackets while four flush-pins at each end test the squareness and length of the arm surfaces that fit the frame. Plugs *A* and *B*, with flattened ends, check the length of the case, while the concentricity of the bore is checked by the dial indicator *C*. These methods can be used in many kinds of work.

A Simple and Efficient Thrust Bearing

By Dexter W. Allis

Light machines, such as motors for phonographs, window-display turntables, etc., require a simple and durable thrust bearing at the base of the vertical shaft that carries the disk. Such a bearing, as shown in the illustration, can be made from two hardened steel balls. One ball is to be driven into a central hole in the bottom of the shaft. The ball should protrude slightly and the projecting portion should be ground flat. The other ball is dropped into the bearing hole and rests in the center of the cone-shaped depression left by the drill. The cavity at the bearing point will retain oil for a long time, and the shaft will run with practically no friction loss. Under a test of eighteen months such a bearing showed no effects of wear.



The bearing

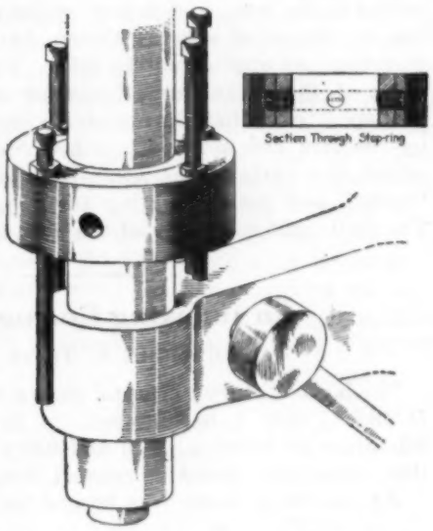
Multiple Stop for a Small Drill Press

By Norman Moore

A small shop having but one drill press of the sensitive type among its equipment, recently devised a multiple stop, as shown in the accompanying sketch, to be applied to this machine in order to facilitate the job of drilling upon a part that was to be produced in considerable quantity. There were four ⅜-in. holes to be drilled to different depths in the piece, and it was desired to hold the work in a jig.

The stop was placed upon the quill above the lower member of the head bracket, it being necessary to partly disassemble the machine in order to put it in place. It consists of two rings of cast iron, one within the other, the inner one being fastened to the quill by means of four special setscrews with round, smooth heads that projected about ⅛ in. outside the ring.

A recess in the bore of the outer ring enclosed the projecting heads of the setscrews and formed the thrust bearing to prevent the outer ring from moving up or down upon the inner one. To assemble the device a radial hole was drilled in the outer ring, passing through to the recess, and through this hole the special setscrews were passed, one at a time; turning the outer ring one-quarter turn after each successive screw was placed to make the hole in the outer ring match with the next hole in the inner one. Four long screws, fitted with locknuts, were put through the outer ring parallel to the axis at points near the periphery, and 90 deg. apart circumferentially. The screw behind the quill bore upon the lower member of the bracket and thus limited the depth of the hole to be drilled. The outer ring turned freely upon the inner one, so that as the operator finished each hole he had but to make a quarter-turn of the ring to bring the next stopscrew into working position. The radial distance of the stopscrews from the center of the ring was such that they would clear the boss of the bracket.



Multiple stop for a small drill press

Lubricant for Threading Copper

By Harry Bilva

In threading copper, the tap or die is liable to clog and bind so that the threads are stripped from the work. Sometimes the binding is so great as to break the tap.

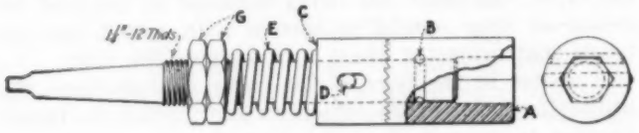
A good remedy for these troubles is to use a lubricant consisting of a thin mixture of white lead and oil. The use of this lubricant will result in good, clean-cut threads.

A Motor-Operated Nut Driver

By L. L. Locke

Applying nuts by hand on the smoke-box end of a locomotive is not a rapid operation, and often it is a difficult task since so much reaching is required. Many railroad shopmen will agree to this statement. To simplify the operation, the driver illustrated is being used by a shop in the west, enabling the elimination of a greater part of the hand labor.

The tool is driven by an air motor, although any form of power can be used. On the end of the body is mounted the hexagon socket *A* and prevented from moving endwise, yet allowed to revolve by the pin *B*. Next to the socket is located the driving collar *C*, con-



The nut driver

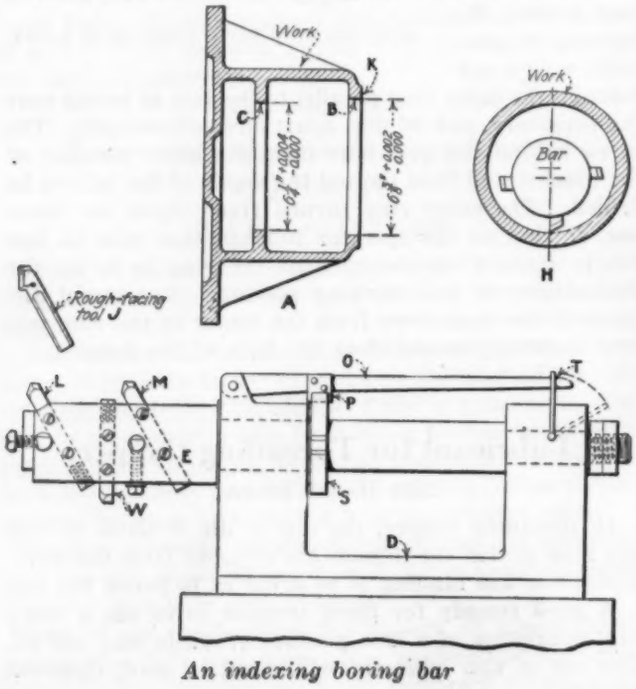
nected to the body, and driven by the pin *D*. The collar has an elongated slot, as shown, to allow an endwise movement of approximately ¼ in. The contacting surfaces of the socket and the collar are provided with V-shaped teeth that form a clutch, kept in engagement by the stiff coil spring *E*. Check nuts *G* are used to adjust the spring pressure. When the nut is driven "home," and resists further turning, the clutch slips. The final tightening only of the nuts is done by hand.

An Indexing Boring Bar

By John K. Trask

The large cast-iron pedestal shown at *A* has two holes *B* and *C* only ½ in. different in diameter, and with tolerances of 0.002 in. at *B* and 0.004 in. at *C*. Due to their sizes they cannot be reamed, but must be bored.

An old 36-in. lathe was rigged up specially for the job. The carriage was fitted with an adapter plate on which was mounted the fixture *D*, carrying an indexing type of heavy boring bar *E*. The toolblock was removed so there was no crosswise adjustment to the boring bar. It was set off center as shown in the end view *H* and all adjustments were made by setting the various tools.



An indexing boring bar

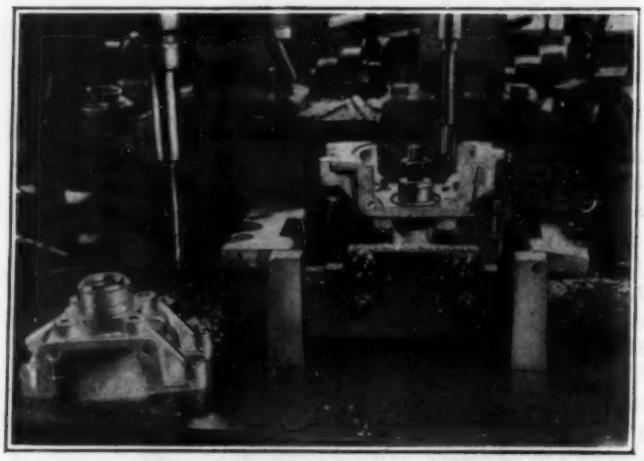
The first tool is a rough-facing tool *J*, which removes the scale from the end of the work at *K*. This tool is then removed from the bar and the rough-boring tool *L* substituted. Tool *L* rough bores diameter *C*, while the other tool *M* rough bores *B*. The boring bar is well supported in the fixture *D* and can be indexed into three positions. The lever *O* carries a V-shaped pawl at *P*, which enters a corresponding slot in the periphery of the indexing collar *S*, attached to the bar. The lever is made very long, and a bail clamp at *T* is used to hold it in position. The finishing tools for *C* and *B* are at 90 deg. from tools *L* and *M*, while the sizing tool *B* is 180 deg. from the roughing tools, and midway between them as shown at *W*.

A finish sizing cut is not necessary for the diameter *C*, which is not as accurate as *B*. The final facing cut on the end of the casting at *K* is done with another tool similar to *J*, but having a slight angle to chamfer the hole. This arrangement works out very well in actual practice since high speeds or coarse feeds are not possible because of the thin wall of the casting.

Drill Jig for Small Crankcases

By C. W. Frank

Making aluminum crankcases for outboard motors presented a problem of designing a jig that would handle all the drilling in one setting, to suit the quantity of production required, and that would bring all the holes in line with one another. The illustration shows the jig used. It is of the turnover type and is provided with double jig-leaves. A work piece is placed in the jig, being located from the center hole and clamped by a U-washer and nut. The jig-leaves then



Drilling a small crankcase

are swung in drilling position and locked by screws at the rear. Drilling is accomplished from four sides.

After drilling has been completed, the work is released, turned over and reset on the locating plug, so that four of the holes can been counterbored from the bottom face.

Design of Helical Springs for Compression or Extension

Formulas for Computing Helical Springs

Deflection per load F_x/P_x	For compression $+$ For extension $-$ $\frac{-h_m+h_x}{H_s}=\frac{F_x}{H_s}=\frac{k}{G}\frac{P_x}{}\frac{D^3}{d^3}$	For ○ wire $k=8.00$ " □ " $k=5.60$
Safe maximum load P_m	$P_m < m\frac{Sd^3}{D}$	For ○ wire $m=0.39$ " □ " $m=0.42$
Safe max. deflection F_m	$\frac{F_m}{H_s}=\frac{H_m-H_s}{H_s}<n\frac{S}{G}\left(\frac{D}{d}\right)^2$	For ○ wire $n=3.14$ " □ wire $n=2.33$

The deflection, F_X, Fig. 1, of a spring is directly proportional to the load, P_X, provided the limit of the material is not exceeded. For a spring of given design the load per unit deflection is not affected by heat-treatment, and is only changed by altering the

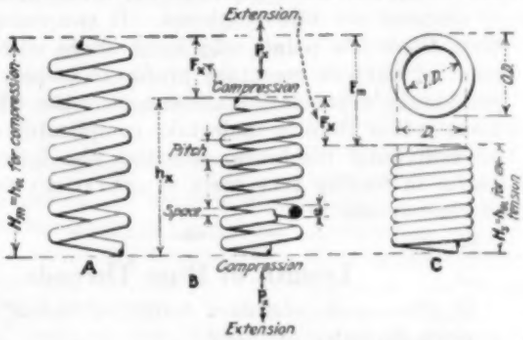


Fig. 1—Live coils covered by formulas. A—Unloaded, or free, length for compression spring, and safe maximum length for extension spring. B—Loaded spring. C—Unloaded, or free, length for extension, and minimum for compression spring.

dimensions or material of the spring. The practice of giving a high temper to a steel spring in order to obtain a greater maximum deflection shortens the life of the spring and makes it brittle.

By referring to the tabulated formulas and Fig. 1 any helical spring of either the extension or compression type, of either square or round wire and having a constant diameter, may be computed.

The dimensions in Fig. 1 cover the live coils as shown, and all figures employed in the formulas must be based on these assumptions. In Fig. 2 are shown typical ends for either compression or extension. These ends are considered "dead" as far as spring action is concerned, and are not covered by formulas.

The torsional modulus of elasticity, designated by the symbol G, is taken as 11,700,000 lb. per sq.in. for drawn steel wire of all compositions and tempers. For hot-rolled or drawn steel bars of 1-in. diameter or more, G equals 10,800,000 lb. per sq. inch.

The maximum safe torsional fiber stress, designated as S, varies with the grade and size of steel wire and conditions of service. A range of from 60,000 to 100,000 lb. per sq.in. should be used if possible. The tensile strength modified by a factor of safety is not used as a safe maximum working stress in spring design, but this stress is kept below the proportional limit. How far below this limit the working stress should be taken depends upon the fatigue limit of the spring material under the type and magnitude of the service load and the total number of repetitions of this load required for the life of the spring. Thus for a 0.036-in. music-wire spring to be operated only 50,000 times by a load ranging between zero and maximum, a safe working stress of 115,000 lb. per sq.in. could be used. On the other extreme, a 1-in. bar-spring to be operated about 10 million times by a load ranging between 50 per cent and maximum during its entire life, a safe working stress of 50,000 lb. per sq.in. is used.

When designing the extension type of spring the assumption is that the initial tension is zero, though in practice it is usually greater than zero, and when

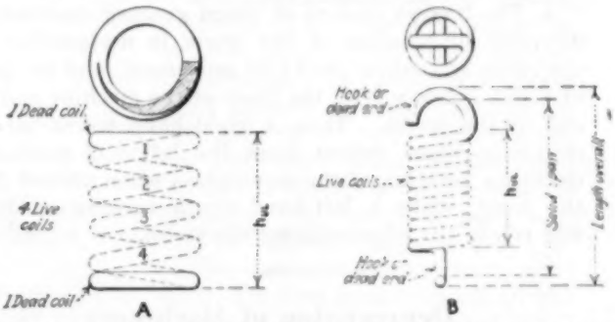


Fig. 2—Typical dead coils not covered by formulas

known should be treated as a constant and added to the load. The spring index, $\frac{D}{d}$, should always be greater than 4, and preferably greater than 6; that is, the mean diameter of the coil should be at least 4 or 6 times the diameter of the wire. In a compression spring of square wire the solid height, H_s, will not measure exactly the length of the number of live turns times the thickness of the wire for the reason that the square section will distort. The compression or extension of a spring should be more than $1\frac{1}{3}$ times the closed coil length; that is, the ratio, $\frac{100F_M}{H_B}$, should be less than 150. In computing helical springs it is assumed that the diameter of spring and pitch are uniform throughout.

Contributed by Jos. Kaye Wood

© American Machinist

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Cracking of Leather Belts

Q. Can you enlighten us as to the cause of cracking in leather belts? We are using good quality belting, and find that cracks develop in the various brands.

A. You are apparently permitting your belts to become dry and hard. You should instruct your millwright or foreman in the proper lubrication of belting. Many mechanics seem to have the idea that belt dressing is merely to keep the belts from slipping. The specially prepared belt dressings usually contain animal oils that lubricate and preserve the leather of the belt. All belts should be given an application of a good dressing from time to time. This is, of course, assuming that your problem is concerned with an ordinary machine shop. If the belts are operating in a chemically impregnated atmosphere that affects the leather you may be obliged to change to another class of drive.

Direction of Rotation of Worm Gearing

Q. In designing the direction of rotation of a worm drive is it proper to specify the direction of the worm or of the wormwheel, and what is the basis for designating the direction of rotation?

A. The largest makers of worm gearing consider the direction of rotation of the worm in designating the clockwise or counter-clockwise movement, and the point of vision is taken from the front of the machine and left end of the worm. Thus, a right-hand worm turning clockwise when viewed from the left will produce a clockwise rotation of the wormwheel when viewed from the front, while a left-hand worm turning clockwise will rotate the wheel counter-clockwise.

Depreciation of Machinery

Q. How should we figure the replacement fund on a machine of a given value to include interest for a period, say of 25 years?

A. The problem is one of straight geometrical progression. If the interest rate is 5 per cent the fund for each dollar will increase to 1.05 dollars at the end of the first year, and continue to increase by the constant factor of 1.05. You can, therefore, use the formula $X = F \frac{(r - 1)}{(r^n - 1)}$, where X equals the annual replacement charge; F equals the fund at the end of the period, equivalent to the cost of the machine, r equals the interest rate plus 100 per cent, and n equals the number of years. The annual replacement charge for a $1,000 machine to be replaced in 25 years, assuming the fund to draw interest of 5 per cent, would be

$$X = 1{,}000 \frac{(1.05 - 1)}{(1.05^{25} - 1)}, \text{ or } \$20.95.$$

In actual practice a period of life shorter than 25 years would be assumed in the calculation. In practice, moreover, machinery does not ordinarily depreciate by equal stages over a long period. A machine may depreciate 50 per cent in sale value the first year, and then by easier stages through the rest of its life. Or, long before it is worn out, it may become obsolete by the introduction of improved methods. If the machine should be replaced for "obsolescence" at a period of 5 years, when only $115.78 has been accumulated in the replacement fund, the remainder is theoretically chargeable to the new machine replacing it, though other means of disposal are also employed. It can readily be seen from these few points why large shops with an assortment of various machines prefer to employ a straight percentage depreciation allowance on the whole department rather than to undertake complicated calculations on individual machines, although the latter are very useful in finding true costs of operations for purposes of comparison.

Length of Pipe Threads

Q. How is the standard length of thread derived for a given diameter of pipe?

A. The formula given for calculating the length of perfect thread for the Briggs' standard pipe thread is $L = (4.8 + 0.8D) \frac{1}{N}$, where D equals the actual external diameter of the pipe and N equals the number of threads per inch. The total length of thread then equals the length of perfect thread plus 2 flat-topped threads plus 4 chamfered threads. Calculating for a 3-in. pipe with actual outside diameter of 3.500 in., and 8 threads per in., gives:

$$L = (4.8 + 0.8 \times 3.5) \frac{1}{8} = 0.95 \text{ in.}$$

Adding 6 more threads, or 0.750 in., gives 1.700 in. as the total length of thread for a 3-in. pipe.

Inertia Not a Force

Q. Can you tell me what it means to "stop the inertia?"

A. Inertia is that property of matter by which it tends to remain at rest when at rest and to continue in motion when in motion. The principle of inertia is one of Newton's fundamental laws of motion. Inertia is not a tangible thing, but is a "state of a body." By the first law of motion a body once started in motion will continue forever unless acted upon by friction or some other external force. Therefore, it is meaningless to use the term "stop the inertia." The phrase "overcome the inertia," however, is used to indicate the external force applied to start a body in motion or to change its motion when it is in motion.

Technical Abstracts

Do Not Be an Imitator

It is a safe rule of life never to do a wrong even for commercial gain. Do not let fear of the way the other fellow is constructing his machines cause you to change your course simply because the crowd is cheering. The louder the crowds shout the soooner they disperse and all is silent again, leaving us time to think and wonder why they cheered. Do not let fear of your competitor's moves cause you to abandon truth, and, above all, do not imitate; imitation is suicide. Fear has always been my worst enemy. It will also be yours. Don't let that enemy beat you. Charles H. Norton in *Grits and Grinds*. May, 1926, p. 12.

Design for Oxwelding

It is impossible to achieve the maximum advantages of oxwelded construction unless the original design contemplated the use of this modern method of making joints. It is a lazy engineer who takes a design developed by cut-and-try experience with riveted construction and merely substitutes welding at the joints.

The detailing and locating of the individual seams is done in accordance with relatively few general principles as follows: first, arrange for thorough penetration; second, prevent overheating; third, avoid compound stresses; and fourth, prevent internal strains. To take one example, the prevention of overheating rules out the joining of thin sections to thick ones and the welding of lapped seams where strength is to be considered. Structures and joints must be properly designed if the best results and greatest economies are to be expected.—*Oxy-Acetylene Tips*, June, 1926, p. 205.

Foreman's Influence on Industrial Relations

Management and workers have mutual interests in the problem of making the best living possible commensurate with ability, and it is up to the foreman to make this plain to the men. He should encourage his co-workers to think along lines of safety, efficiency, quality, self-improvement, thrift, and co-operation. Both the company and the men save money when there are no accidents. Similarly efficiency—the use of energy to best advantage—is of mutual interest. The maintenance of quality is an assurance of steady employment, since it keeps orders coming in. Wasteful habits and attitudes are eliminated when a man strives for self-improvement and cultivates thrift. Co-operation is doing the job better than expected.

The greatest tact is required by the foreman when a worker's anger, jealousy, or suspicion has been aroused. Conditions based on the principle of a square deal to all should prevent such occurances. The desire to excel and to win the admiration of others is common to all men and it is up to the foreman to cultivate this ambition in his men. A foreman should always take the time to show a man how to do a job, although the foreman might do it quicker himself, since skill is the result of effective instruction. R. D. Bundy in the *Foremen's Magazine*, July, 1926, p. 15.

Multiple Breaking

In breaking a bar into billet lengths it is essential to notch it on one side and to apply the fulcrum on the opposite side so that the effect will be to open up the bar at this point.

The same principle can be used in breaking up steel bars at several points with the same stroke of the press. A gage is used to locate the points and the bars are "nicked" by means of an acetylene torch. The nicks are alternated on opposite sides of the bar. Fulcrums are placed behind each notch whether it is on the upper or lower side of the bar. A stop or bumper is placed on the end of the press bed so that the bar will be gaged at a point where the fulcrums will correspond with the notches.

When the pressure is applied the bar can be broken into five or six billets at one stroke. The pieces will be "zig-zagged" over and under the fulcrums. W. R. Ward in *Transactions of the A. S. S. T.* July, 1926, p. 119.

Planning and Routing Shop Work

Of the methods that have lately been applied to reduce production costs, planning is one of the most important. In all factories, however small, there should be a planning department; even if is consists of but one man. The planning department determines what work should be done, and how; what tools and equipment shall be employed; what time completed and semi-completed parts shall be delivered to other departments.

Planning, properly carried out, will cut down the quantity of material in process, and it will also reduce the amount of finished work necessary to be carried in stock by reason of the factory working closer to the demands of the sales department. From data at hand in a planning department it is possible to compile standard costs—the lowest costs that can be obtained—and these, checked against actual costs, enable the manager to determine factory efficiency.

Without a schedule, or proper planning, it is practically impossible to make promises regarding delivery of material. The planning engineer must prevent even the least important piece from being side-tracked, for if the whole is not completed and shipped there are no returns to the company; the customer pays only for the finished product.

The planning department must know the characteristics of all the machinery in the shop and what operations can, and should, be performed upon the various machines. There should be an understanding in the shop that when men run out of work or machines are idle the planning department should be notified. Progress of work must be reported by all shop foremen to the planning department.

Poor transportation can upset a factory. It is really the function of the planning department and should be placed under the control of a capable man.

Planning is the foundation of all business; whether large factory or corner grocery. In order to be successful the work must be planned step by step. J. Seton Gray, in *Machinery* for June, p. 776.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

Established 1877

A Pat on the Back

THERE is something about praise that induces sustained effort. A sentence or a letter of praise to the individual now and then keeps him on his toes. When several individuals work together for a common result the praise must go to the group. In the shop the group is the department.

Human nature does not change radically as the child grows into a man. Both like their associates to know of their successes. Visible recognition of merit is a very powerful influence toward continued effort. It is not always necessary to give monetary rewards such as increases in pay or bonuses, although as a general policy it is logical for a man to receive payment by results.

One successful and efficient railroad repair shop is rewarding its departments for a clean and orderly shop by allowing the department making the best showing for a week to display a banner during the following week. The banner is a simple reward, but it works. The men take genuine pride in possessing it. They know, and all the other men in the shop know, that to display it is an honor. Individual effort and department effort result. There is a spirit of friendly rivalry throughout the plant that makes the day's work something more than merely part of a job.

There is no difference between the psychology of giving stars for class attendance of children and that of displaying a banner in the shop. Both are visible recognition of merit, both make for continued effort, and both take into account the human equation.

What Is an Engineer?

EVEN the colleges are at odds as to what training and abilities enable a man to acclaim himself an engineer. Many of the older technical schools have taken the raw material, worked it hard for four years and turned it loose on the world with the degree of engineer. Others have taken the stand that no four-year course, no matter how arduous, can turn out a real engineer. They hold that practical experience is a vital necessity.

Several schools have tried five-year courses. A few have experimented with six-year ones—and the result has been disastrous. Why? Because the average boy will not wait longer than four years to get into the thrilling combat that is life, when one is twenty-two. Many cannot afford a longer non-earning period.

A recent announcement from Lehigh University, one of the most successful exponents of the four-year plan, shows the trend of the times. Hereafter, a student will be graduated after four years as a bachelor of science in the particular branch of engineering in which he has specialized. After five years of engineering experience, and on the presentation of an acceptable thesis, he will be granted his engineer's degree.

The substitution of liberal studies for some of the purely technical ones given in the past is an excellent feature of the plan, for most of us engineers must admit the lack of liberality in our own training. Lehigh's solution is commendable but there are many who will rise up and argue its soundness.

Lighting Practice and Subnormal Eyes

THE prevalent intensities of illumination in our industries are far from adequate for normal or "perfect" eyes. Futhermore, improper lighting resulting in glare, annoying shadows, and reflected high-lights adds to the strain upon vision. Another important factor that should encourage better lighting is the predominance of imperfect eyes. Of 2,500 employees in two large post-offices, the U. S. Public Health Service found 74 per cent had one refractive error or more and only 36 per cent wore glasses. Only 17 per cent had normal eyes and a large percentage had really serious eye-trouble.

Of course, correcting glasses should be worn because, in general, they are advantageous to the worker. But this does not bring the individual up to the par of the minority which have "perfect" eyes. It has been proved that subnormal eyes require greater intensities of illumination and other better visual conditions in order that they may see as well as those with "perfect" eyes. This becomes a matter of great importance when we accept the fact that the majority of workers' eyes are imperfect. If good lighting were the rule throughout the industries the majority of workmen would only have the one handicap—that of eye-deficiency. Corrective glasses do not entirely wipe out this handicap. But good lighting is not the rule so we should recognize the fact that most of us are doubly handicapped.

The percentage of near-sightedness and other eye-defects increases as the average age of a group of workers increases. The percentage of normal eyes decreases rapidly beyond the age of forty years. In lighting practice this means that a relatively higher intensity of illumination should be supplied in those industries where skilled labor is important, because, in general up to a certain point, skill is acquired with age.

Shop Equipment News

Cincinnati Bickford Plate and Rivet-Hole Driller, Heavy Type

The heavy type plate and rivet-hole driller illustrated was designed for boiler, tank and structural shops by the Cincinnati Bickford Tool Co., Cincinnati, Ohio. Fig. 1 shows the front view of the machine, while Fig. 2 shows the rear view.

The machine is a special type of radial drill having a base mounted on wheels and arranged for traveling under its own power on a track parallel to a bench or trestle, on which the plates to be drilled are stacked. As many plates as the length of the twist drill will permit are stacked, and a plate from a previously drilled lot is used as a template. The bench should be long enough to support two stacks, so that while one stack is being drilled the other can be loaded. The operator runs the machine along the track from one stack to the other. Except for the labor gang required to stack and remove the plates, one operator is necessary to operate the machine. It is claimed that the duplication of holes is such that reaming is practically eliminated. It is also claimed that drill breakage is rare because of the rigidity of the machine.

The arm of the machine is of box-type construction and is heavily ribbed throughout its entire length so as to resist bending and torsion. Although the arm is massive, it is said to swing under light pressure so that the operator can position the drill with minimum effort. The weight of the arm assembly is carried upon hardened steel rollers that bear on a hardened and ground steel ring mounted in the base of the machine. The rollers are, in turn, mounted upon roller bearings. An extension on the rear of the arm supports the driving motor, which can be furnished in either a 10- or a 15-hp. size. The arm can be furnished in 4-, 5-, 6- or 7-ft. lengths, depending upon the maximum width of the plate that is to be drilled.

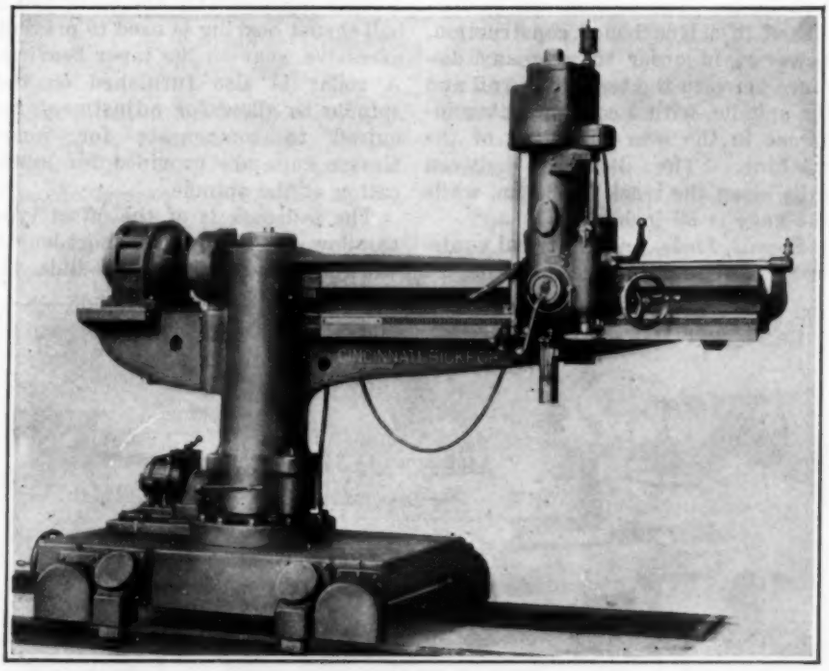


Fig. 1—Cincinnati Bickford Plate and Rivet-Hole Driller, Heavy-Duty

The column upon which the arm swings is secured to the base by means of a heavy flange. It is reinforced throughout with heavy ribbing. Provision is made on the lower part of the column for clamping the arm rigidly in position while drilling. The large amount of clamping surface provided is said to prevent any side movement of the arm, so as to prevent drill breakage. A hand lever for clamping is furnished as standard equipment, but the machine can be furnished with either an electric-motor clamping device or a double-acting, compressed-air clamping device. The control of both these mechanical devices is located on the head near the spindle for convenience of the operator. The head is moved along the arm by means of the large handwheel on its right, which moves the head 1¼ in. for each revolution. About one-eighth of the revolution of this handwheel is lost motion, so that a hammer blow effect results, which is claimed to facilitate fine adjustment of the head on the arm for alignment of the drill with the holes in the template. The head is fully inclosed and the entire mechanism is protected from dirt and chips. A selective sliding-gear type of transmission is incorporated in the head for obtaining four changes of speed. The feed is changed through a lever-operated dive key. The gears and shafts are of heat-treated alloy steel. Clutches are provided that permit the spindle to be started, stopped, and reversed. They are operated by a lever located at the right of the spindle. These clutches are fully inclosed and run in oil. They are accessible for adjustment.

The spindle itself is made of a special analysis alloy steel having an ultimate tensile strength of about 200,000 lb. per sq.in. It is hardened so as to assure a long life of the tang slot and the taper in the spindle nose that is usually subjected to severe treatment. The feed rack and feed pinion are also made of the same material. Ball thrust bearings are provided at both the top and the bottom of the spindle sleeve.

The feed trip automatically dis-

Shop Equipment News

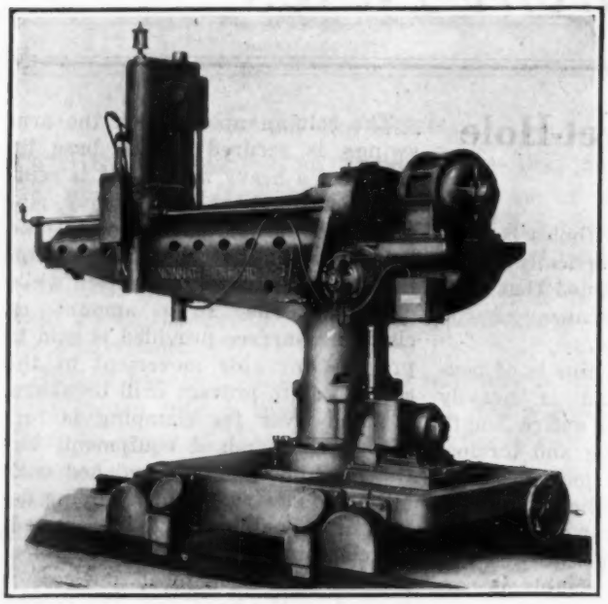


Fig. 2—Rear view of machine

engages the power feed when the drill penetrates the bottom plate of the stack. It acts directly on the main feed clutch. This design is said to result in less movement on the part of the operator for each hole drilled.

A countersinking attachment can be furnished extra. It consists of a long lever attached to the feed pinion shaft, which provides a powerful lever feed to the spindle. With this attachment the operator can position the head and arm with one hand and countersink with the other.

The base of the machine is of heavy construction. It is strongly reinforced with heavy flanged ribs. The wheels are of steel, machined and carbonized. They are mounted on roller bearings and are protected by means of suitable guards from dirt and chips. Provision is made for locking the machine to the rails by means of four clamps located near the wheels. These clamps grip both sides of the rail head and are operated simultaneously by a large-sized handwheel. An equalizing system secures uniform clamping.

A 2-hp., constant-speed motor mounted on the base furnishes power for propelling the machine on the track. It is geared direct to the axle through a worm drive and is controlled by a reversing drum-type controller. If the travelling feature is not desired, the machine can be equipped with either of two types of stationary base, a short base that merely serves as an anchorage, or a standard drill base that has a large working surface with the usual T-slots. If it is found practical to have one man operate two machines located on opposite sides of the bench on which the plates are stacked, the machines can be equipped with right and left arms, in order to reduce to a minimum the distance traversed by the operator in going from one to the other of the stacks.

The spindle of the standard machine is equipped with a No. 5 Morse taper and has 18 in. of travel. Its lowest position is 38 in. from the rail top and its highest position is 56 in. The maximum spindle radius with a 4-ft. arm is 5 ft., and with a 7-ft. arm is 8 ft. In all four models the minimum spindle radius is 20 in. The standard over-all height from the rails to the top of the head is 9 ft. 5¾ in. The column can be furnished in a lengthened construction, however, in order to give any distance between the top of the rail and the spindle, with a corresponding increase in the over-all height of the machine. The distance between rails along the track is 63½ in., while the gage is 59 inches.

Speeds, feeds, and electrical equipment can be furnished to suit.

Sloan & Chace Bench Precision Lathe, No. 6

The No. 6 bench precision lathe, manufactured by Sloan & Chace, Inc., 351 Sixth Ave., Newark, N. J., has been completely redesigned. It can be used for a wide range of general lathe work and attachments are provided for screw cutting and for the grinding of automobile engine valves. The machine can be used also for internal and external grinding and for resharpening reseating cutters, for which suitable attachments are provided. It is also equipped with a diamond tool wheel redresser.

The bed of the No. 6 lathe is provided with flat ways which are machined and scraped. A heavy rigid casting makes the tool suitable for heavy-duty work. It is of a wide design so as to provide large bearing surfaces for the head- and tailstocks and for the cross-slide which is of the compound type.

A headstock with a three-speed cone pulley is supplied. At each end of the headstock is an eccentric bolt that can be turned by means of a key wrench. The eccentric bolt draws up the clamping bolts which hold the head solidly so that it will not loosen with vibration while in operation. The spindle is fitted with a plain and a taper bearing. On the outer end a ball thrust bearing is used to prevent excessive wear on the taper bearing. A collar is also furnished on the spindle to allow for adjustment required to compensate for wear. Grease cups are provided for lubrication of the spindle.

The tailstock is of the offset type to allow the turning of short-length work and to clear the cross-slide. It

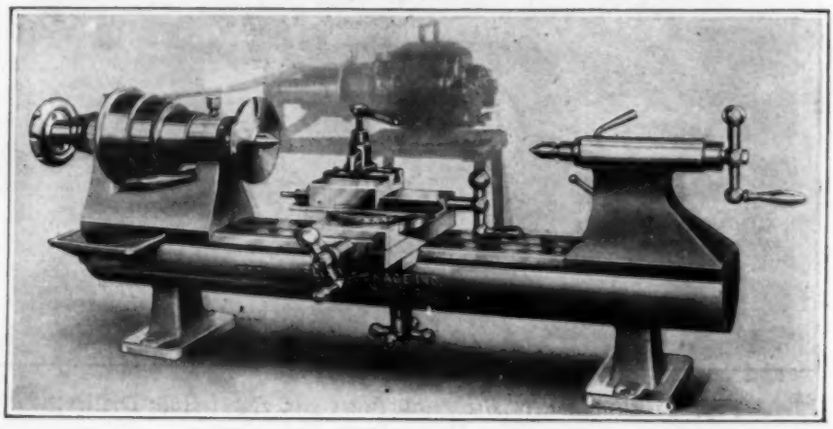


Fig. 1—Sloan & Chace Bench Precision Lathe, No. 6

Shop Equipment News

can be clamped in any position along the bed. A keyway ⅛x⅛ in. in the spindle prevents it from turning. An adjustment similar to the one on the headstock spindle is also provided. Both the headstock and the tailstock are cored out underneath so as to reduce their weights.

The compound slide rest has guide plates which can be clamped along the ways to keep the slide rest in rigid alignment with the two spindles and the ways. It is provided with the usual clamping mechanism for securing it in any position. The two screws have Acme square threads. They have adjusting screws and bushings to take up the end play and to serve as end bearings for the screws. The ways of the slides are gibbed. Each feed screw and the swiveling tool rest have graduated dials. The dial for the toolrest is

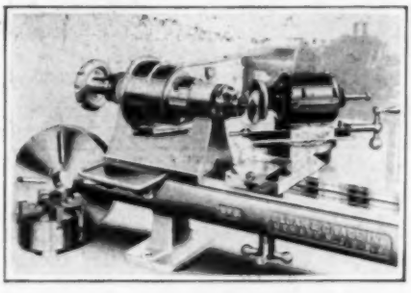


Fig. 2—View showing valve-grinding attachment

graduated up to 90 deg. on each side of the center or zero line. The toolpost will take ⅝x⅝-in. Armstrong toolholders, or ⅝x⅝-in. solid tools.

On the bed of the lathe at the side of the headstock is a small shelf which can be removed. A T-slot at this end of the bed is then used for clamping the screw-cutting attachment. The headstock spindle is keyed for the main driving gear which operates the change gears on the attachment. The end of the screw for the upper slide projects at the back in order to connect with the knuckle joint of the attachment so that it will serve as the leadscrew for thread cutting.

Bronze nuts are used on both slides. The end bushings for the feed screws are made from hardened steel. Machine steel is used for the feed screws. The spindles are made from tool steel, hardened, ground and lapped. The bearings are also made from tool steel finished in the same manner. They are of the two-taper type, 1⅞ in. in diam. and 2 in. long.

Thirty-eight inches is the length of the bed. The maximum distance between centers is 18 in. Work 10 in. in diam. can be swung over the bed and 6 in. in diam. over the compound slide rest. The hole through the main spindle is 1¼ in. in diam. and that through the draw-back spindle is 1⅛ in. in diam. Nine inches is the diameter of the faceplate. The distance of travel of the upper slide is 5¼ in. and the lower slide can be moved a distance of 5 in. It is equipped with a chuck and a dog-carrier faceplate.

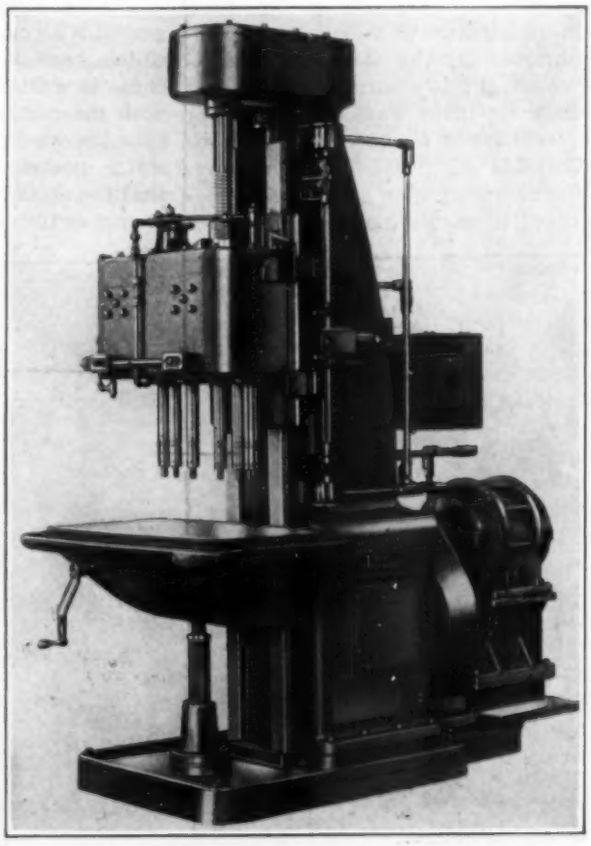
The machine is driven by means of a ¼-hp. motor either backgeared or driving through a countershaft providing six spindle speeds, 60, 130, 180, 186, 340 and 590 revs. per minute.

Defiance Multiple-Spindle Vertical Tapping Machine, No. 10

The Defiance Machine Works, Defiance, Ohio, is placing on the market its No. 10 multiple-spindle, fixed-center tapping machine. The machine, shown in the accompanying illustration, is designed as a single-purpose production machine, and is especially built to meet the requirements of gas engine manufacturers for tapping spark plug holes and similar work. The production claimed is from 30 to 45 tapped blocks per hour. The machine is of the vertical type with a heavy frame casting having a cored center. The frame has extra broad planed slides with the full length of upright carefully scraped to accommodate the sliding surfaces of the head and table.

The fixed-center head, which carries the spindles, is built with 4, 6, or 8 spindles, spaced to suit the requirements of the purchaser. The spindles are made of high-grade forged steel and are supported in bronze bearings with ball-bearing thrust carriers. A feed mechanism operates the head up and down on the slide. All feed shaft bearings have bronze bushings, and the feed gears are selected to correspond with the number of threads in the holes to be tapped. The head has a maximum vertical travel of 12 in. Adjustable stops are provided to regulate the travel from 2 to 12 in. The spindle head can be stopped or reversed at any position. It reverses automatically at the bottom of the travel, and also stops automatically at the top of the stroke.

The table is mounted on a heavy screw, which permits it to be raised



Defiance Multiple Spindle Vertical Tapping Machine, No. 10

Shop Equipment News

or lowered by means of a crank at the front of the machine. The working surface of the table measures 20x36 in. The maximum open space between the nose of the spindle and the top of the table is 32 in. The distance from the center of the spindle to the face of the column is 8 inches.

The machine has a direct-connected motor drive controlled by a push button, and is equipped with automatic trip and cut-outs. A 10-hp. reversible motor with a magnetic reversing switch is the standard equipment for the machine, but changes are made to suit the electric current available. The floor space occupied by the machine is 33x66 in. The net weight of the 4-spindle machine is 5,800 lb., that of the 6-spindle machine is 6,000 lb., and that of the 8-spindle is 6,200 lb. The shipping weight of the last is 7,000 pounds.

Acme Upsetting and Forging Machine, Heavy-Duty

The Acme Machinery Co., Cleveland, Ohio, has placed on the market an improved line of heavy-duty upsetting and forging machines. The illustration, Fig. 1, shows the type of machine, which is made in ten sizes ranging from $\frac{3}{4}$ to 5 inches.

A feature of the machine is the all-steel construction. The bed is a one-piece steel casting strengthened by deep ribs and trusses. This construction is designed to give a bed capable of withstanding the most severe strains to which it may be subjected, at the same time excessive weight is eliminated. The bed has three main crankshaft bearings of sufficiently heavy construction to eliminate all possibility of spring. The operating side of the bed is designed to enable the operator to get as close to the work as possible.

The crankshaft is a special steel forging carefully heat-treated. It has been increased in size over the older models. An improved cam on the shaft is intended to operate the movable die smoothly and rapidly. It has a hardened tool-steel face at the point where the work is heaviest. The cam also operates against large hardened-steel rollers in a toggle slide.

The machines are powerfully backgeared with cast-steel cut gears. The clutch gear at the side of the machine is webbed in order to do away with the customary unsightly guard over the whole gear. There are two clutch pockets in the gearwheel, so that the operator has two chances of engaging the clutch in one revolution of the gearwheel. The clutch pockets in the gearwheel hub are lined with hardened-steel blocks. A flywheel is keyed to one end of the driving-pinion shaft. This wheel is heavy enough to balance the machine, and is provided with a friction relief safety device to relieve the machine of excess strain if it should be stopped suddenly when in operation.

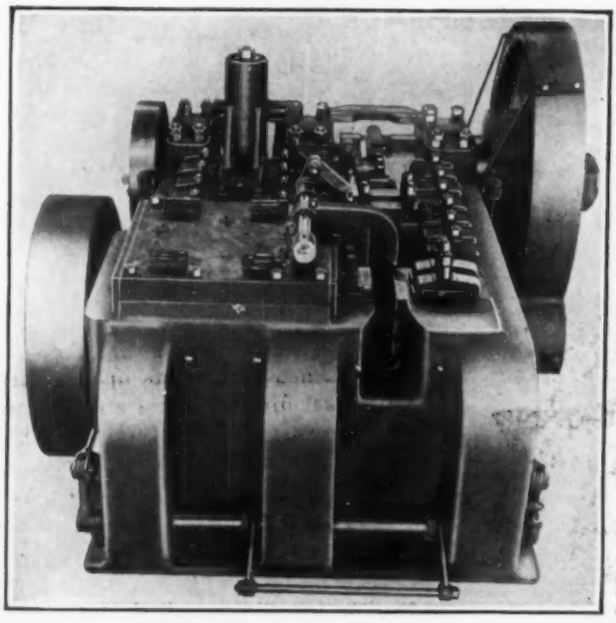


Fig. 1—Acme Heavy-Duty Upsetting and Forging Machine

The header slide, shown in Fig. 2, is of massive steel. It is suspended on long, wide bronze bearing surfaces in recesses on top of the bed. This construction prevents dirt, scale, and water from entering the bearing surfaces. The side surfaces of the header slide operate against ground plates in the ways of the bed. The pitman pin is inserted from one side of the slide, and a holding block is keyed and bolted in a fitted slot.

The movable die slide is of steel, and has the same improved suspension as the header slide. The construction of the slides is claimed to keep the whole toggle system free from dirt, at the same time reinforcing the machine at this point. The toggle slide is of two-piece construction. The lower part is carried on large wearing plates operating in the toggle slide ways. The top part carries the relief mechanism and also

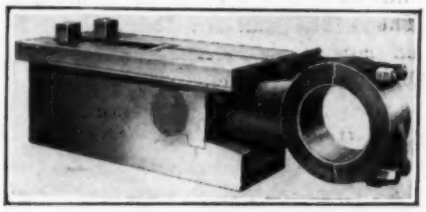


Fig. 2—Header Slide and Pitman

the hardened steel rollers on which the cam operates. The relief mechanism in the toggle slide is said to give a very large capacity for squeezing work between the dies, but a positive relief if anything should be caught between the faces of the dies and cause an excessive pressure on the machine.

An assembly of the toggle system is shown in Fig. 3. The long toggle pins are integral with their connecting bodies in order to give greater rigidity. The double toggles on the heavier sizes of machines are claimed to maintain an absolutely parallel position of the sliding die.

The machine is fitted with a heavy

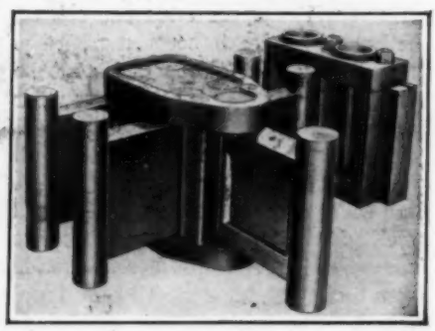


Fig. 3—Double Toggle Cluster

Shop Equipment News

stock gage and an improved back stop. The latter is made of a heavy steel I-beam fitted with an adjustable sliding head. A strong brake is also provided that stops the machine in the proper position when the clutch is disengaged. All wearing parts of the machine are provided with bushings, wearing plates, or liners that can be replaced easily in case of wear. Improved oil reservoirs and grooves insure ample lubrication to all slides, bearings, and other moving parts.

A motor drive is furnished with the machine when desired. On the 2-in. machines and larger the motor is placed on a bracket bolted rigidly to the machine, and a silent chain drives directly to the flywheel shaft. The ¾- to 1¼-in. machines are gear driven from the motor located on a bracket at the rear of the machine. The area of floor space taken up by the ¾-in machine is 4 ft., 8 in. x 7 ft., 9 in., and that for the 5-in. machine is 13 ft. x 15 ft., 6 inches.

Cincinnati-Acme Universal Flat Turret Lathe, No. 8, Improved, Duo-Control

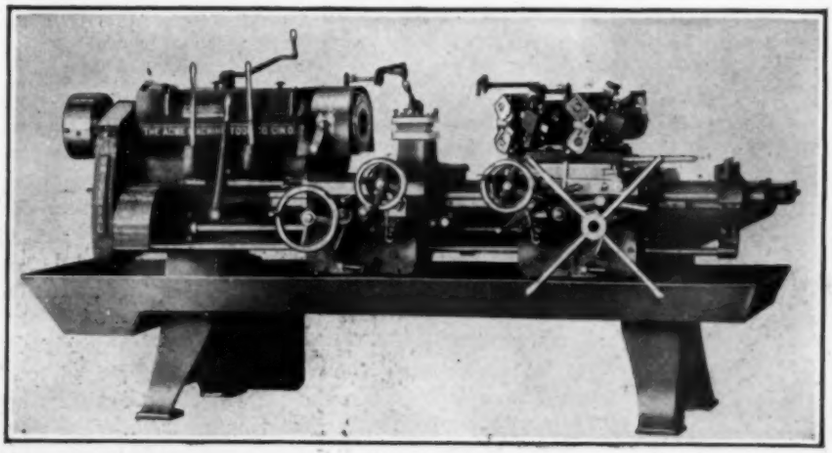
The Acme Machine Tool Co., Cincinnati, Ohio, has made several changes in the design of the No. 2 universal flat turret lathe illustrated. The original machine was described on page 50, Vol. 58, of the *American Machinist*. Full chucking equipment is shown. Bar equipment and a chasing attachment are also provided.

An automatic brake that is synchronized in action with the clutch is incorporated in the headstock. When the operator desires to change the speed he moves either one of two levers. The movement automatically disengages the multiple-disk main drive clutch, and at the same time sets a brake so that the gears rotate very slowly, or not at all, while the shift is being made. In this way the speed can be changed from the lowest to the highest without noise, and without disengaging the driving power.

The feed-change box formerly placed at the end of the bed has been eliminated. In the present design both the turret and the side carriage are provided with twelve independent feed changes, selected by means of a single rod so that the operator need not change his position. The feed-changing mechanism is mounted on ball bearings, and is completely inclosed. It runs in a bath of oil.

The thread-cutting attachment has been re-designed so that it is possible to cut a thread the full distance between the turret face and the chuck face. The bracket that carries the half nut for screw feed is arranged so that it can be mounted on either the side or the turret carriage. The bracket is held by means of three screws. In this way it is possible to cut threads on die-heads or taps with tools arranged on either carriage.

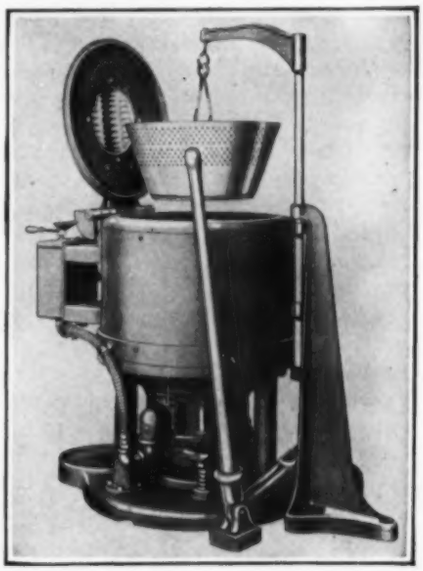
Other minor improvements have been made.



Cincinnati-Acme Universal Flat Turret Lathe, No. 2, Improved, Duo-Control

"Curtis" Electrically-Heated Dryer

The Leon J. Barrett Co., Worcester, Mass., successor to the Curtis Machine Co., has brought out an electrically-heated machine for the purpose of drying small parts, such as screw-machine products, stampings, etc., that have to be washed in soda or potash solutions to clean them for polishing and plating.



"Curtis" Electrically-Heated Drier

The machine consists of a base, supporting a stationary shell, or drum; a motor-driven revolving unit within the drum; and an electric heating unit permanently mounted in a grid, which is a part of the cover. The revolving unit is made up of a special General Electric a.c. motor with an extension shaft reaching to the top of the drum, over which shaft is set a conically shaped shell to contain the work to be dried. The machine is made in two sizes, rated by the holding capacity of the work-container as 1 and 2 bushels, respectively.

The weight of the driving motor and attached parts rests upon a ball and socket directly under and in line with the axis of rotation, and the unit is maintained in an upright position by four heavy coil springs, equally spaced about the frame of the motor. The springs hold the unit upright during the time it is at rest and absorb the shock of an unbalanced load while the unit is accelerating and decelerating. When

Shop Equipment News

running at normal speed, the unit together with the load revolves upon its own center of gravity and there is no shock or vibration.

The work-container is a drawn-steel shell, perforated with small holes to allow passage of air. The centrifugal action of the work container sucks air into the machine through openings in the heating grid located in the cover. The inlet capacity of the heating grid, and the combined area of the small holes in the wall of the container are so proportioned that no fluctuations in pressure or a backdraft can occur.

The motor is reversible and is controlled by the drum switch located on the side of the machine. The handle may be locked in one position for continuous running; in the reverse position it can be held only by the hand of the operator against the action of a coil spring. The machine may be brought to rest quickly by reversing the motor momentarily. The machine may be accelerated to normal speed of 1,145 r.p.m. in 10 sec. and stopped in 12 seconds by reversing the motor.

The hinged cover in which the heating unit is located is connected to a safety device that prevents the machine from being started while the cover is in the raised position; conversely, it prevents the cover from being raised while the machine is in motion.

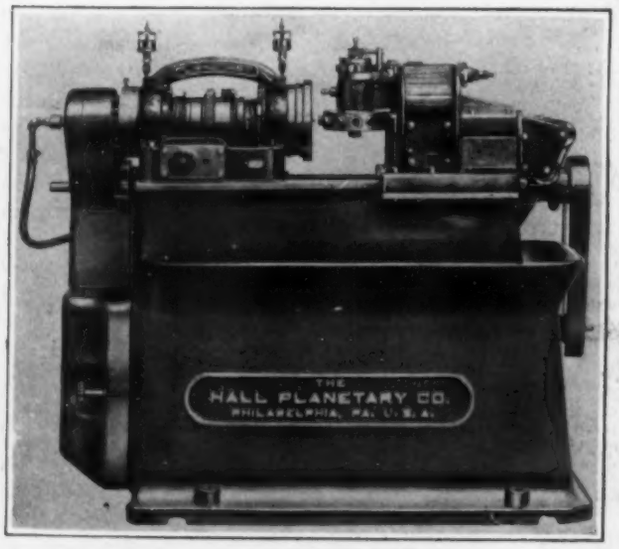
A lever-operated crane provides a convenient means of lifting the loaded work-container. The containers are interchangeable and as many as desired may be provided for each machine. Motors can be furnished for use with 220-, 440-, and 550-volt, 60-cycle, alternating current. Special motors for 25-cycle current at any commercial voltage are supplied at extra cost. The heating unit takes its current from the same source as the motor, and is turned on and off by the handle of the controller as the motor is started and stopped.

The floor space occupied by the machine is about 5x7 ft. and the shipping weight is approximately 1,300 pounds.

Hall Planetary Thread Milling Machine

The automatic planetary thread milling machine shown in the accompanying illustration has been placed on the market by the Hall Planetary Machine Co., Fox St. and Abbotsford Ave., Philadelphia, Pa. The machine is designed for the handling of work of any shape. The pieces to be milled are placed in a large hopper, from which they are fed into the revolving turret and chucked. When the thread is milled the part is thrown out of the turret onto a belt conveyor or into a receptacle.

The work is carried in the collets in the turret. When the work comes in line with the thread milling cutter, the turret moves forward toward the planetary head, at the same time the piece is tightened in the collet. The thread milling cutter moves automatically from its dwell position to the depth of thread, and makes one complete revolution in its planetary orbit. It then returns automatically to dwell, and the turret moves away from the head of the machine and revolves to the next station. The coolant is pumped through the hollow spindle and forced into the flutes of the cutter at a pressure of from 5 to 15 lb. per sq.in. in order to keep the thread free from chips.



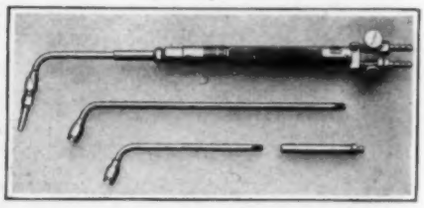
Hall Planetary Thread Milling Machine

The machine is especially designed to handle such operations as milling cap nuts of hard steel, which would be difficult to tap. It is claimed that the milling cutter will not tear the threads and will produce an accurate thread with a fine finish. A production of from 8 to 12 threads per minute is claimed.

The turret for small work is operated by a special cam, while for larger work an air or oil cylinder is used. The head of the machine is bolted directly to the bed, thus eliminating sliding ways and gibs and making a more rigid construction between the cutter and the work. The motor drive is located in the base under the head, and is connected to the spindle by a silent chain. Ball bearings are employed throughout.

Airco-Davis-Bournonville Welding Torch, Style 7700

The style 7700 Airco-Davis-Bournonville welding torch illustrated has been placed on the market by the Air Reduction Sales Co., 342 Madison Ave., New York, N. Y. When used with oxygen of a purity of 99.5 per cent, or better, this torch has a gas consumption ratio of 1.01 volumes of oxygen to 1.00 volumes of acetylene. This ratio of gas consumption is a practical attainment of the theoretical one-to-one gas ratio required for a perfectly neutral flame. With the improved torch design an excess of oxygen is not required in order to lessen the danger of backfiring. A soft, hot, non-oxidizing flame is produced that makes high quality welds possible.



Airco-Davis-Bournonville Welding Torch, Style 7700

The torch is well balanced, even when the longest extension tube and the largest tip are used. The various possible combinations of extension tubes, mixers, and tips provide for a general or special purpose torch

Shop Equipment News

covering the full range of welding, from sheet metal to heavy forgings and castings. This torch has been approved by the Underwriters' Laboratories.

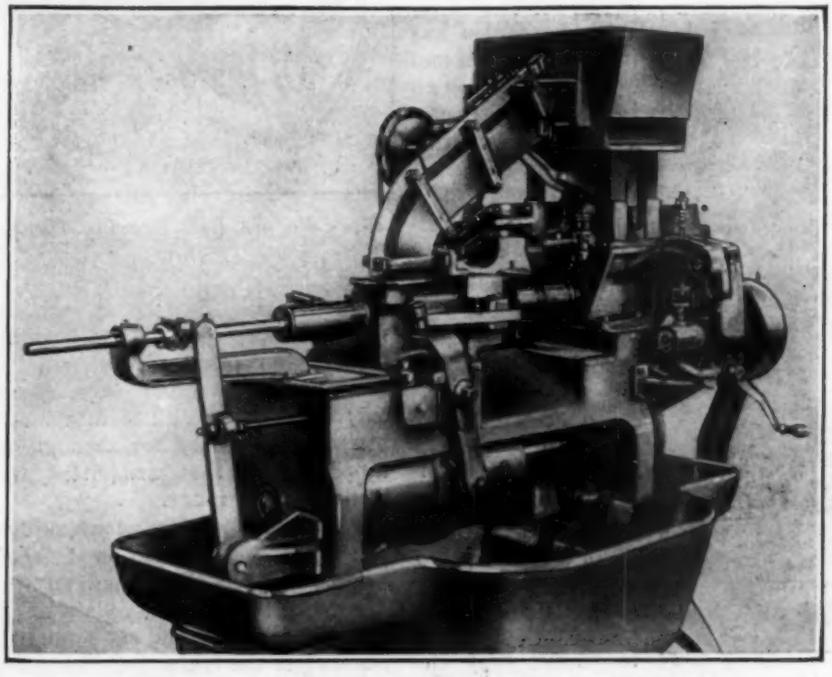
The rear end of the torch is a brass forging with large gas passages. The handle is made of seamless, knurled brass tubing, and is secured to the head and to the rear by means of four brass screws. The head is made of a special bronze, and the tip nut is phosphor bronze. The oxygen and acetylene tubes are seamless, drawn brass tubes, silver-soldered to the head and to the rear end. A mixing head, three extension tubes, 6, 9 and 16 in. long, and ten welding tips, ranging in size from Nos. 1 to 10, are provided. The acetylene consumption of the various tips ranges from 2.4 to 89.9 cu.ft. per hour.

The hose connections are straight, and are for use with $\frac{3}{8}$-in. hose. Quick-acting needle valves control the gases. The overall length of the unit is 11½ in. without the mixer and extension tube, while the weight is 19 oz. The complete weight with the 8-10 mixer, the 9-in. extension tube, and the No. 10 tip, is 30 ounces.

Kent Automatic Cap-Screw and Bolt-Threading Machine

The Kent Machine Co., 268 N. Water St., Kent, Ohio, has placed on the market a cap-screw and bolt-threading machine in two sizes. The machine may be adapted to the threading of cap screws, machine bolts, or special bolts. The machine is automatic in action, and is adjustable to accommodate the specified range of sizes.

The hopper feed is so designed that the only change needed for different sizes is in the agitating plate in the center of the hopper. The required number of these plates is furnished with each machine. They are readily attached and detached in a few minutes. The delivery chute from the hopper to the machine proper is adjustable within the range of the machine. When the machine is used for threading cap screws the chute from the hopper delivers the cap-screw blank to a carrier, from which the blank is transferred to holding jaws for the threading operation. The cap screw is held by the head of the blank, and an internal trip on the die head regulates the length of thread on the screw. When threading bolts the action of feeding is very similar to that of the cap screw just described, with the exception that the bolt is held in the clamping jaws by the shank, so that the thread is cut concentric with the shank.



Kent Automatic Cap-Screw and Bolt-Threading Machine

After the blank has been fed to the threading position the threading spindle carrying the die head is automatically advanced. When the screw or bolt has been threaded the desired length, the die head automatically opens and backs off the blank. At the same time the gripping jaws that hold the cap screw are automatically released, and the finished product is positively ejected from its threading position by an incoming blank. The action of threading and ejecting is so rapid that there is no appreciable air-cutting time. The machine is built in two sizes, arranged respectively for handling cap screws up to and above ½ in. in diameter. The smaller machine is designed to accommodate screws 3½ in. under the head, and will thread the body of the screw a length of 2½ in. The larger machine will thread screws 4 in. under the head, and will cut a thread 2½ in. in length.

The machines are belt-driven by a single belt from a countershaft. The machines are simple in design and sturdy in construction, and they are readily adjustable for the specified range of sizes.

"Wear-Ever" Quick Change Chucks and Collets

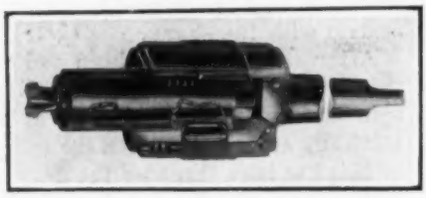
A line of quick-change chucks and collets is being made by Scully-Jones & Co., 2012 West 13th St., Chicago, Ill., under the trade name "Wear-Ever." The chucks provide a means for changing tools without stopping the machine, and a series of operations, such as drilling, reaming and tapping, can be performed with a single spindle while the work is held in a fixed position.

The chuck is a cam type with two long rollers acting as the driving wedges. The main body of the tool can be furnished with a standard Morse taper shank or a straight shank. The remainder of the assembly consists of a knurled removable collar for engaging and releasing the collet, a collar spring,

Shop Equipment News

the collet, and the two rollers. All parts are made of heat-treated steel.

The action of the chuck is rapid. A light grip on the knurled collar releases the tool, while the tool can



"Wear-Ever" Quick-Change Chuck and Collet

be inserted by holding the collar back against the spring pressure. The spring insures immediate engagement of the rollers with the collet.

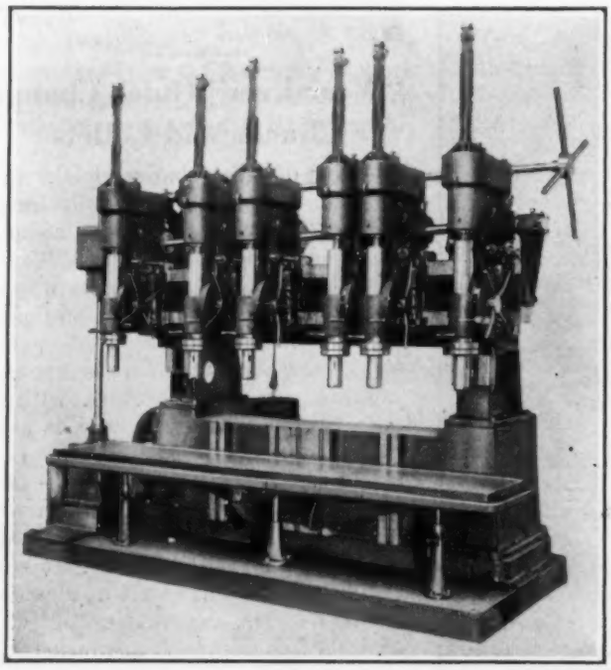
The collets are made in several standard styles and are hardened and ground. Standard collets fit all size Morse taper-shank tools, and by means of adapters straight-shank tools, such as drills and taps, can also be driven. Style A collets are short and permit the tangs of taper-shank tools to project beyond the slotted end so that the tool can be removed without the use of drifts. Style B is for use with drifts, while style C drives by the flat and is for use with drills with broken tangs. Blank collets finished only on the outside can also be furnished.

The chucks are made in five sizes, accommodating taper shanks ranging from Nos. 1 to 6 Morse taper. The outside diameter of the chucks varies from 1⅛ to 2⅝ in., while the length of the chuck bodies ranges from 1⅞ to 5 in. The collets are numbered to correspond with the chuck numbers. No. 1 collet accommodates No. 0 and 1 Morse tapers, and No. 5 collet, Nos. 3, 4 and 5 Morse tapers. Other sizes range between. The outside diameters of the collets vary from 1⅛ to 2⅜ inches.

Rockford Rail Drilling Machine

The Rockford Machine Tool Co., Rockford, Ill., has brought out a production rail drilling machine that is claimed to be of rigid construction and is designed with all details proportioned to meet the heavy loads of operation at maximum capacity.

The rail drilling machine is shown in the accompanying illustration. The table is supported at six points, and is anchored. Two milled T-slots run the full length of the table. The heads of the machine have individual adjustments operated by a crank through a rack and pinion on the rail. The minimum distance between the center line of the heads is 9 in. Each head also has individual speed and feed changes through "pick off" gears. The spindle speeds can be varied from 150 to 940 r.p.m., with a maximum feed of 0.040 in. Each spindle has an automatic quick approach and return, and an automatic stop.



Rockford Rail Drilling Machine

All bearing surfaces are said to be of ample dimensions, and are scraped to fit. Gibs are provided where necessary to take up wear. The rail is counterbalanced to permit easy elevation. The elevating screws are hung on ball thrust bearings and are operated by bevel gears and a star wheel.

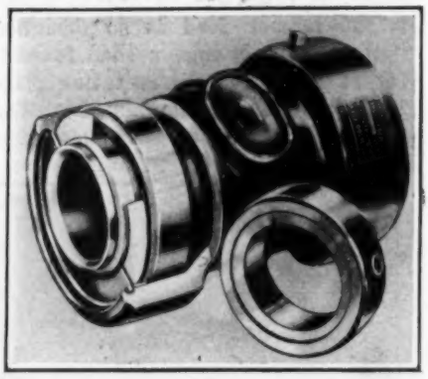
The speed and drive shafts are equipped with ball and roller bearings. The minor feed bearings have bronze bushings. The machine is provided with from two to six spindles, as required. The spindles are fitted with No. 4 Morse taper.

The machine is furnished with either motor or belt-drive. A variable-speed d.c. motor is recommended and, when furnished, is mounted on the base at one end of the machine.

Wood-Fafnir Ball Bearing Hanger Boxes

Fafnir ball bearings are now used in a standard line of hanger boxes made by T. B. Wood's Sons Co., Chambersburg, Pa.

The housings are made in several styles with bosses designed to suit different types of hanger frames, so that plain babbitted bearings can be replaced without disturbing the hangers. The box is the so-called dumb-bell type, and it carries a



Wood-Fafnir Ball Bearing Hanger Box

single-row ball bearing at each end. Enclosures are provided to keep dirt out and to retain the lubricant. It is said that lubrication is necessary only twice a year. The lubricant is introduced into the box through two tapped holes that are fitted with standard pipe plugs.

The boxes require no adjustment when they are mounted on the shaft. The box is slid along the shaft into place and two locking collars are located at each end and set screwed in place after the frame bolts have been drawn up.

Shop Equipment News

Cincinnati Side-Head Boring Mill, 6 Ft.

The Cincinnati Planer Co., Cincinnati, Ohio, is manufacturing the 6-ft. boring mill, illustrated, with a rapid-traverse side head. Fig. 1 shows the front view of the machine. The side head is capable of machining work of any height within the capacity of the mill, and the ram is constructed so that it can reach almost to the center of the table. With this third head the work can be turned while it is being bored and faced.

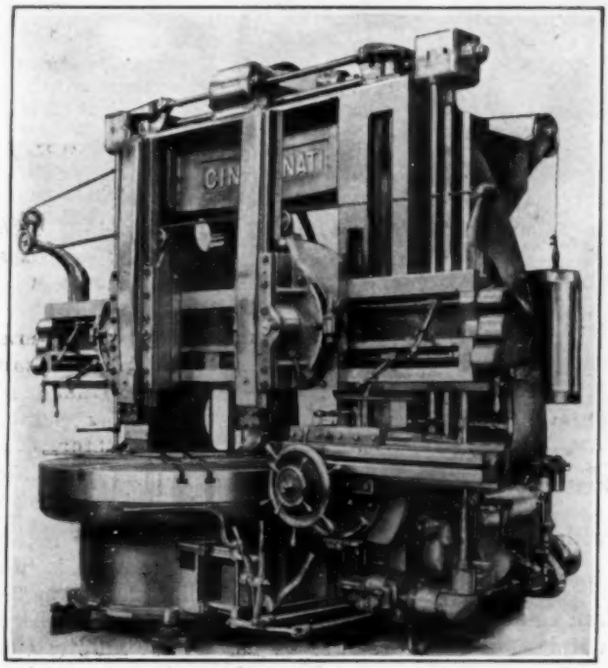


Fig. 1—Cincinnati Side-Head Boring Mill, 6 Ft.

The side head has rapid-power traverse in all directions, obtained by means of an individual motor placed on the side of the housing.

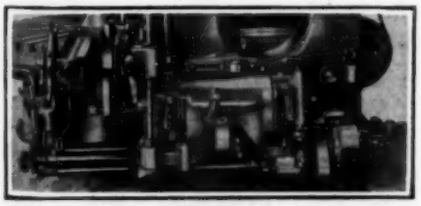


Fig. 2—Power Traverse mechanism for the side head

The motor is controlled by means of a drum controller, the movements of which are interconnected with a direction shifting lever. Hence the head can be made to move up and down, or in and out, by means of a single lever. The arrangement of this control is shown in Fig. 2. The feed is automatically disengaged when the rapid power-traverse is thrown in. The control for the side head on the boring mill does not interfere with the traverse mechanism for the rail heads. The latter is placed on the opposite side.

The construction of the housing and saddle is similar to that of the rail and saddle. A narrow guide is embodied in the housing to eliminate twisting of the saddle. This housing face is considerably wider than that on the left of the machine. The housing is securely bolted and dowelled to the bed, and with the construction described it is possible to run the side head to its extreme limit and still take a large cut. The ram is made of cast iron and has a removable steel rack that can be replaced if damaged. Taper gibs are used throughout the head.

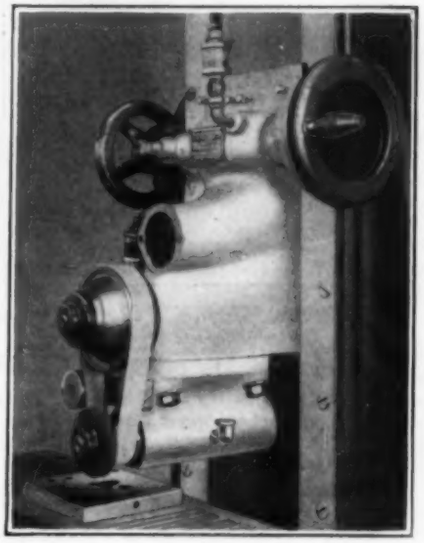
The side head can be provided with a crowning or taper attachment. A thread-cutting attachment can also be supplied, if necessary.

The change levers for the table drive have been brought to the front of the machine on the same side as the side head. The start and stop levers are in the same position.

"Abrasive" High-Speed Surface Grinding Attachment

The Abrasive Machine Tool Co., East Providence, R. I., has placed on the market a high-speed attachment for its No. 3 surface grinding machine. The attachment, shown in the accompanying illustration, is claimed to have been developed especially for gage and tool work where wheels of small diameter are required.

Provision is made for mounting small wheels close to the bearing, and extension wheel arbors are also furnished. Each wheel arbor is fitted with an integral pulley of the proper diameter to give the correct wheel velocity. The wheel spindle is massive, and is mounted on ball bearings, which are protected against the admission of abrasive dust.



"Abrasive" High-Speed Surface Grinding Attachment

Power is derived from a pulley mounted on the main spindle in the wheel adapter, and is transmitted to the grinding spindle by an endless canvas belt. An idler pulley mounted on ball bearings provides means of maintaining the belt-tension.

Van Keuren "Handy" Plug Gage Set

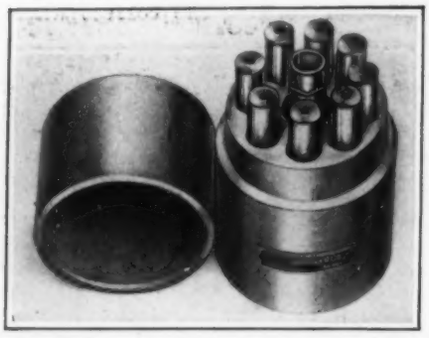
The Van Keuren Co., 12 Copeland St., Watertown (Boston), Mass., is marketing the "Handy" set of interchangeable limit plug gages shown in the accompanying illustration. This set comprises a hollow handle with spring grip at each end, into which any two of the seven ground and lapped plugs may be placed.

Of the seven plugs that go to make up the set, one is of exact nominal size and three are, respectively, 0.0005 in., 0.001 in., and 0.002 in. oversize; the remaining three are undersize by the same amounts. Each plug is plainly marked with its nominal size and the amount of plus or minus deviation. All of the plugs are double-ended, with the two ends

Shop Equipment News

alike in sizes and thus two wearing surfaces are obtained.

To make up a go-and-no-go gage 0.001 in. plus or minus tolerance, for instance, the plus 0.001 in. plug



Van Keuren "Handy" Plug Gage Set

is placed in one end of the handle and the minus 0.001 in. plug in the other. Other combinations suggest themselves. There are twenty-one combinations available in each set.

These sets are now made in standard 16th-in. sizes ranging up to ½ in.

Lawson 24-In. Pipe Wrench

The 24-in. pipe wrench shown in the accompanying illustration has been placed on the market by the Lawson Manufacturing Co., 6505 Carnegie Ave., Cleveland, Ohio. The wrench is made entirely of drop-forged steel, and has the movable jaw made integral with the handle.

Lawson 24-In. Pipe Wrench

The latter feature is intended to add strength and to give accessibility with less assembled parts.

A coil spring holds the jaws open so that the wrench can be put on a pipe with the use of only one hand. When the wrench is released, the spring tends to disengage it from the pipe, and permits the wrench to be moved back for a new hold without injuring the teeth. The design is similar to the smaller wrenches made by the company in sizes from 8 to 18 inches.

Taylor & Fenn Contour Milling Attachment

The Taylor & Fenn Co., Hartford, Conn., is marketing the contour milling attachment illustrated for use in connection with its vertical milling machine, a description of which appeared on page 1108, Vol. 50, of the *American Machinist*. The attachment can be used to mill cams and other pieces with irregular-shaped contours.

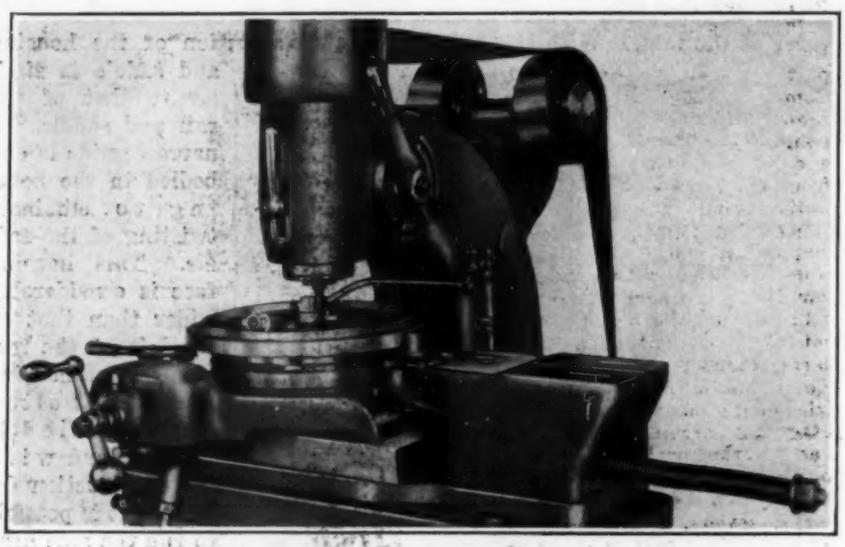


Fig. 1—Taylor & Fenn Contour Milling Attachment

The attachment is fastened directly to the power-feed rotary table of the standard vertical miller as shown in Fig. 1. The required shape is produced by means of a former-plate fastened to the table. The former plate is held by spring pressure against a pin having the same diameter as the milling cutter, and as the table rotates the entire fixture moves back and forth in V-guides according to the shape of the former-plate. Speeds and feeds can be varied to suit the requirements. The cutter rotates at high speed.

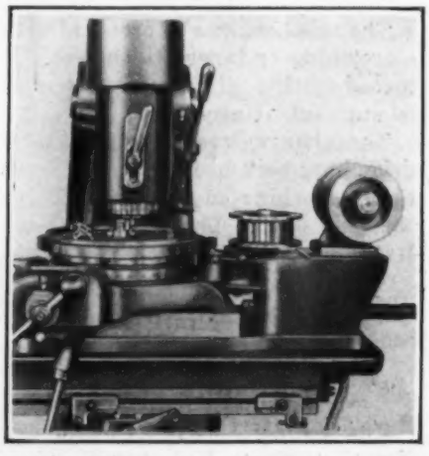


Fig. 2—Generating the former-plate

A generating device is used to make the former-plate from a model or sample of the work. A guide pin of the same diameter as the cutter to be used later is inserted in the spindle of the machine and the model is held against it by means of spring pressure as before. A milling cutter replaces the guide pin against which the former-plate is later held. This cutter is driven by means of gears and a belt as shown in Fig. 2. As the table rotates, the entire fixture moves in its slides as controlled by the shape of the work model that bears against the guide pin in the spindle.

"Fibroc GR," Gear Material

A self-lubricating Bakelite gear material, known as "Fibroc GR," is being marketed by the Fibroc Insulation Co., Valparaiso, Ind. The material contains graphite as a constituent, together with Bakelite, so that the teeth of gears made from this material are self-lubricated. An increase of gear life of 35 per cent is claimed for this material. Fibroc can be cut rapidly, and it is silent in operation.

News of the Week

DeBerard Becomes Chief Engineer in Chicago

W. W. DeBerard, western editor of *Engineering News-Record*, has been granted a leave of absence to become chief engineer of the Chicago Regional Planning Association.

The association is a corporation not for profit which has enlisted the support of the county boards, the Chicago Commonwealth Club, University of Chicago, Northwestern University, Union League Club, the City Club, many cities and villages, chambers of commerce, firms and individuals. The area covered is that territory within commuting distance of Chicago, roughly a 50-mile radius covering more than 7,000 sq. miles of land in three states and 15 counties, and including 250 cities and villages, 70 park boards, 40 plan commissions, 8 sanitary districts and a large number of drainage districts. Co-ordination of the construction activities of the many authorities now planning and carrying out public and private works projects is the principal purpose of the association, so that orderly and connected systems of highways, sewers, parks and other public and private works may be developed.

Mr. DeBerard has been connected with *Engineering News-Record* and its predecessor, *Engineering Record*, since 1910, all of that time in charge of the Chicago editorial office. His headquarters with the Regional Planning Association will be in the Burnham Building, Chicago.

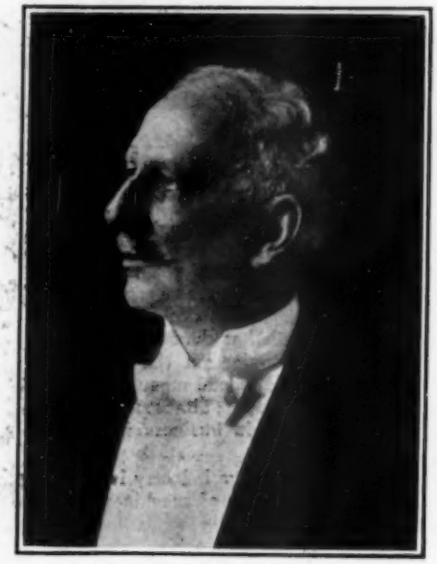
Oberlin Smith Dead at Bridgeton

Oberlin Smith, formerly president of the American Society of Mechanical Engineers and known throughout the world as an inventor and machinery manufacturer, died on July 19 at his home in Bridgeton, N. J. He was eighty-six years old.

One of the most prolific and versatile mechanical inventors of the nineteenth century, Oberlin Smith had an unbroken and highly successful career of sixty-three years as a manufacturing engineer.

The strong inclination toward mechanics which he showed in boyhood led him in 1863 to establish a machine shop at Bridgeton, which in 1877 he enlarged into the Ferracute Machine Co. Of this corporation he was president and mechanical director for the remainder of his life. He produced a great variety of machines, including his own numerous inventions, making a specialty of presses and dies for working metals. Of such machines he designed and manufactured more than five hundred different types, for as many different uses, many of them being for the United States government and others for the Ford automobile works.

He obtained on his own inventions more than fifty patents, eight of them being for cutting, punching, drawing and coining presses, three for drilling



Oberlin Smith

machines, ten for looms, two for soldering machines, two for aërating devices and others for dump carts, pill compressors, keyless locks, wire gages, drink mixers, egg boilers, spring cotters, speed indicators and other contrivances.

He was the author of "Press Working of Metals," "Technique of Machine Design" and other works. He traveled through Europe several times on tours of engineering observation, and was well known among scientists and manufacturers of many lands. He was a member of the American Society of Mechanical Engineers and its president in 1899, and a member of the Engineers' Club of New York, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers and the American Association for the Advancement of Science.

Census of Aircraft Manufacturers

The Department of Commerce announces that, according to data collected at the biennial census of manufactures, 1925, the establishments engaged primarily in the manufacture of air craft built 621 airplanes and 78 seaplanes and flying boats, as against 505 airplanes and 82 seaplanes and flying boats built in 1923, the last preceding census year.

Tool Foremen's Association Expects Record Attendance

At the fourteenth annual convention of the American Railway Tool Foremen's Association, which is to be held at the Sherman Hotel, Chicago, Sept. 1, 2 and 3, it is expected that all attendance records will be broken. This prediction was made by G. G. Macina, secretary, after a recent meeting of the executive committee which is making an effort to have present one or more representatives from each railroad in the country. More than sixty railroads were represented last year and it is expected that this number will be increased to 100 this year.

Many of the superintendents of motive power of the leading railroads have agreed to co-operate by sending their tool foremen and other shop executives. A group of papers dealing with various phases of motive-power maintenance are to be presented, together with the usual sessions on standardization of tools and labor-saving devices.

A.S.S.T. Makes Ready for Convention

The preliminary program for the annual convention and steel and machine tool exhibition of the American Society for Steel Treating has just been completed by the meetings and papers committee which met in Cleveland recently. This committee is headed by Earl Smith, of the Central Steel Co., and includes H. M. Williams, of the Delco-Light Co., J. H. Nead, of the American Rolling Mills, and R. T. Bayless, of the A.S.S.T.

The exposition will occupy the entire capacity of the Municipal Pier, in Chicago, where the convention will be held during the week of Sept. 20. The technical sessions will be held at the Drake Hotel, where headquarters of the convention will be maintained during the entire period of the meeting.

The five days of the combined convention-exposition will alternate with technical meetings, exhibitions and demonstrations and visits to industrial plants in the city and vicinity. The usual luncheon meetings will be held throughout the week, and the annual ball and the annual dinner have their places on the program. W. H. Eisenman, 4600 Prospect Ave., Cleveland, is executive secretary of the association.

The National Regrinders' and Rebuilders' Association recently held its third annual convention at Indianapolis, at which the name of the organization was changed to the "Association of Automotive Engine Rebuilders."

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

(Copyrighted, Theodore H. Price Publishing Corporation, 16 Exchange Place, New York)

THE week's developments in France have brought America face to face with a question that is transcendentally important and very difficult to answer. It is: Can one half the world continue to prosper while the other half faces bankruptcy? An affirmative answer might have been possible before steam and electricity had worked the economic unification of society that exists today, but the financial and commercial relationships of all nations are now so intermeshed that it has become extremely difficult for any one of them to live unto itself alone. This is particularly true of the United States whose investors now hold foreign obligations estimated at over $10,000,000,000.

Therefore it is not surprising that last week's markets showed themselves susceptible to the news from Paris and the decline in the French franc which sold as low as 1.90 and is quoted at 2.25 as this is written.

The frequent and lightning-like changes in the French government make it impossible for an American to form an intelligent opinion of the probabilities, but without meaning to be pessimistic it may be said that serious trouble impends if by inaction the immense volume of franc obligations outstanding is allowed to become valueless. Most of the savings of the thrifty Frenchmen are invested in these obligations and especially in the internal loans called "rentes" that were issued so freely during the war and until recently. Those who hold these loans are called "rentiers" and most of them are still holding on in the fatuous hope that the franc will some day recover its gold value of 19.2 cents. It is doubtful whether many of them yet appreciate that its international value has fallen to less than 2½ cents and it is to be feared that a veritable stampede of liquidation would follow if the mass of the French people became persuaded that the obligations of their government were valueless.

This is why America has come to have such an acute interest in the French situation and it explains the spells of weakness to which our markets were from time to time subject last week.

But grave as it is the condition that exists in France is not irremediable and there seems to be some hope that it will soon be dealt with intelligently and effectively.

Buoyed up by this hope and our own undoubted prosperity most American business men went home cheerful last Saturday evening. The domestic outlook is not entirely flawless but there is nothing serious in sight although some timid souls seem to be alarmed by the political ghosts that usually stalk about at this time of the year. It is reported that several spectres of this sort are now to be seen at the political conventions being held in the Middle West.

One of them is the ghost of a lower tariff and others are members of a spectral committee of agricultural economists that appeared at Des Moines and announced that it had been ascertained that the costs of farm production in Iowa plus a fair profit to the farmer were as follows: oats, 79 cents; wheat, $2.49; corn, $1.42; hay, $21.44; hogs, $16.32; veal, $17.82; wool, 65 cents; lambs, $20.45; chicken, 28 cents; eggs, 61 cents.

Of course these figures are preposterous. If they were true American agriculture would have been bankrupt years ago. Therefore their publication at this time is most unfortunate for it has created an impression that those who lead the farmers are unreasonable in their demands and has somewhat chilled the sympathy with which most Americans would have been prepared to consider any reasonable plan for bettering the condition of those who till the soil.

The same thing might be said of Secretary Mellon's ill-timed attempt to justify the debt settlement arranged with certain of the Allies. It appears to have been unnecessary and the rejoinders it has elicited have vindicated Shakespeare's statement that "a loan oft loseth both itself and friend."

But the mid-summer placidity of business conditions in the United States has not been otherwise disturbed. The F. W. Dodge Co. reports that building permits issued in June, for 205 cities, call for expenditures whose total is 2 per cent under that of the same month last year.

No statistics are available but it is not improbable that the turnover in many other lines of business would show the same ratio of decrease.

This generalization is suggested by car loadings and bank clearings which no longer show the constant gains that were reported until recently.

The cotton market has fluctuated within narrow limits. It was not much affected by Friday's government report which suggested a crop of somewhere between the extremes of 16,628,000 and 13,476,000. The trade ought to be profoundly gratified that these reports have been so thoroughly "denatured."

The improvement in cotton goods is perhaps the most impressive feature of the situation and it leads one to wonder whether the depression so widely advertised two months ago was imaginary or real. Perhaps the subnormality that is reported in some other lines of business may prove to be equally elusive for there is nothing radically wrong in this country and all will be well if Europe can be put on her financial feet and kept in an erect position.

What's Doing in Industry

July began the second half of the year with an unusually active sales program in the machinery field. What is generally expected to be a dull month has developed into a period of buying on the part of many industries, and manufacturers and dealers report almost universal improvement in business in their lines.

The automotive industry is again active, purchases of machinery being made to equip shops for the increased fall production, which is expected to reach new high levels. In Detroit, sales have increased and future activity is assured by present inquiry. Indianapolis reports a slight improvement, though buying is being done sparingly. Automotive accessory plants are busy in New England and are taking on new equipment as production demands increase.

A slight falling off in new orders is reported from Cincinnati, but inquiries have increased and business is expected to follow soon. The improvement in Chicago is holding up and added impetus is given by recent railroad inquiries. Normal activity continues in New York with orders in fair volume.

The South has been a little quiet in the past fortnight, but some good business is pending. In Canada the metal-working and paper industries are busy and are buying rather generously.

General business conditions in this country are sound and progressing satisfactorily. Europe is still unsettled in more than one place, but all will be well if that continent can be put on her feet financially—and kept there.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Detroit

Although activity in the machinery and machine tool field in Detroit and other industrial centers in southeastern Michigan has not reached the proportions of early spring, enough evidences of increased buying on the part of automobile manufacturers are to be found to lead representative machine tool dealers to view with optimism the remaining months of the year.

The announcement of new models and the expected introduction of others is giving the automotive industry a decided impetus, with the result that sales of machinery are on the up-grade.

This is particularly true with the smaller tools, as every plant is tooling up in every department. Special precautions are being taken to guard against any temporary cut in production through failure to have modernized tools. Several large firms report sales of such equipment as milling machines, lapping machines and some presses.

Efforts to find out what will be done with the present Ford car have proved to no avail. Every machinery man in Detroit is watching every move of the Ford organization, as it is believed changes will be made which will call for the expenditure of hundreds of thousands of dollars.

The General Motors plants, taken as a whole, are active buyers in considerable quantities. Hudson and Essex, as well as Chrysler, are buying and the same holds true for Packard and Dodge.

General manufacturing plants are proving better customers of machinery firms than had been expected, while foundries are going full blast.

Chicago

The improvement noted in the machine tool market during the first week in July is being steadily maintained in most lines. Dealers in used tools report a satisfactory demand, the usual falling off in business beginning with midsummer each year having failed to materialize. Inquiries for both new and used machinery are decidedly encouraging, their volume and character indicating that for some weeks to come there will continue a period of activity in the market unusual for this time of year.

The vacation season finds many executives out of town, but those who remain express themselves as well satisfied with present conditions and the future outlook. Railroads are buying in better volume than for some time past. The Burlington has issued a new, although not an extensive list; the Santa Fe is in the market for a number of tools, and the Northwestern is making inquiries for additional equipment. The International Harvester Co. is still placing orders for its Rock Island plant.

Demand for woodworking machinery is showing improvement, due to increased production in the furniture manufacturing industry. All things considered, the optimism generally expressed in the machinery trade seems to be well founded.

New England

The amount of over-time operations in machinery building plants in the Connecticut section of New England is a fair index of the condition generally prevailing in the industry in this part of the country. A concern manufacturing special machinery for the automotive industry is operating about 30 per cent of the plant on a 24-hour schedule. The machinery is required for contemplated increase in production for next year's models. Another industry, also allied with the automotive trade, is operating 20 per cent of its plant on a 65-hour weekly schedule. Other plants were found where production requirements necessitate operations until 8 or 9 o'clock every night.

The statements of factory officials are couched in such general terms as "fine," "holding up better than we anticipated," and "we see no indication of any slowing up." The buying is very general, all the principal industries being well represented, and there is also good export business.

Some sizeable plant expansions in Hartford are in progress to meet the requirement of heavier output.

New York

There has been no slowing up of buying activity in the local machinery market in the past week. Orders continue to come in for single tools and in a few isolated cases for three or four pieces to make up a new battery for some special work.

Inquiries are quite active, one dealer stating that he has received more inquiries this month than in any month this year to date. There is no evidence of a summer dullness and agents and dealers believe that the present active condition of the market presages a good fall season.

The second-hand market is active. Buyers have assumed the privilege of accepting just what tools are offered them, providing the price is attractive. Some good bargains have been picked up of late.

Railroad buying was quiet in the past week, only a few scattered orders being reported in this territory. Small tools and shop supplies are not as active as they were the first half of the month.

Cincinnati

Compared to the preceding week, the Cincinnati machine tool market experienced a slight falling off in orders during the past week, but business was better than in the same period of the previous year, taking it as a whole. However, a few manufacturers report that they did a little better than hold their own, and none report more of a decrease in demand than is to be expected at this season.

The greater portion of the orders booked during the week called for single tools for replacement purposes, these coming from various sections of the country. Railroads and concerns in the automotive industry did some buying, but the majority of orders came from general machinists and industrial users of machine tools. The purchases were well diversified as to sizes and types and there was no perdominating market.

Selling agents report that inquiries came in quite freely during the week, and while most of these were for single tools some were for good-sized lists. No more than the usual amount of summer dullness is reported by this branch of the industry, and it is stated that business was better in the past week than in the corresponding week of last year.

Factory production remained at its former level during the week and it is thought that the orders booked and those coming in will maintain manufacture at its present point until the early fall, when an increased demand is confidently expected.

Canada

Despite seasonal declines in some branches the condition of the metal-working industry as a whole in Canada is fundamentally sound. Reports from all sections of the Dominion indicate continued improvement in production of iron and steel, automotive manufacture and building and construction.

It is reported that there are sufficient locomotive orders on the books of the Canadian Locomotive Co. to keep operations going at a steady rate throughout the summer and into the autumn. The Canadian Car and Foundry Co. has about 250 per cent more orders on its books than it had at this time last year. William Hamilton Ltd., Peterboro, Ontario, manufacturers of saw and pulp mill machinery, report that while business in the sawmill machinery line is only fair, they have closed some nice contracts in pulp mill equipment and water turbines.

Considerable business is in prospect for the steel industry. A large amount of steel is expected to be consumed by the proposed big warehouse to be built in Montreal, while the construction work at Arvida, on the Saguenay, is providing much business, both for mills and warehouses. It has been announced that the Sydney steel mills of the Dominion Iron and Steel Co., which is now in the hands of a receiver, will continue to be operated without interruption. The nail and wire mills have been operating spasmodically for several weeks, but it is reported that orders just secured in Western Canada insure four months' full-time operation.

Contracts for preliminary construction work on the proposed Limoilou, Quebec, mills of the Anglo-Canadian Pulp and Paper Co. will be placed in the near future.

Production of 81,277 tons of steel ingots and castings in June was 9 per cent under the 89,513 tons of May, but 29 per cent higher than the 63,140 tons of a year ago.

Indianapolis

A slight improvement is noted in machinery and machine tool business here in the last two weeks over the same previous fortnight. The outlook is very promising. At the present time the automobile industry is buying tools in small quantities but virtually no machinery, but plans already are started in various shops throughout the state for fall production, which will necessitate more machinery and will increase the tooling requirements.

Judging from the reports local automobile executives are receiving from their dealers, the fall will see more production than last fall. The same virtually is true of the automobile accessory plants here. In viewing the situation as a whole, there is more encouragement for the trade in this area than there was at this time last year.

Railroad buying is slight, and this creates a hole in the volume of the entire trade. With the fall season approaching, however, several shops are to increase repair programs.

One of the best sources of business now seems to be in small lathes, grinding machinery and other miscellaneous equipment for garages. Dealers say this business is much better than it was last year and they expect it to continue good.

Dealers in used machinery report a rather ready sale for small lathes and other equipment, but big tools seem to have little call.

Southern District

In spite of the unusually hot weather in the past two weeks, which has slowed up industrial activity, machine tool business has shown little abatement. Building is active in the larger cities and there is still a fair call for contractors' equipment and machinery, while road construction also continues active all over this section.

Smaller shops are a little slow but have lately been improving their purchases, though their buying is largely of used and rebuilt equipment. Service stations and garages continue to be very active buyers in this district, with July proving one of the largest months in the past year or more. Considerable new machinery is also being purchased in this field, though orders are still heavy for used and rebuilt tools. The outlook promises continued active buying through the rest of the summer.

The textile industry remains more or less inactive, but the inquiry from this source is still picking up and there is promise of better than normal business for the latter part of the summer and during the fall. Sales have been just a trifle better in the last two weeks than they were the preceding two weeks.

Railroads are inquiring on a fair basis and are also buying to some extent, but are not as active as they were. Farm machinery continues to show substantial gains over last year, particularly tractors, which are also being widely sold for industrial use.

First Six-Cylinder Car in Switzerland

The first six-cylinder automobile ever manufactured in Switzerland has been placed on the market in that country by the Neue Automobil Atstien-Gesellschaft Martini, located at St. Blaise, in the Canton of Neuchatel, according to consular advices to the Department of Commerce from Zurich. The price of the chassis is announced to be Swiss francs 13,000 ($2,510) and the complete cars will cost between francs 15,000 and 18,000 ($2,900-$3,475).

The Martini factory produced its first motor vehicle in 1897. It is, therefore the oldest Swiss automobile factory and claims to be one of the oldest in the world. The original Martini cars were adapted to the mountainous roads in Switzerland and are said to have become popular in that country and elsewhere in Europe because of the power of their engines. The company experienced financial difficulties at the end of the World War, however, and stopped producing automobiles. Subsequently, a new company was formed under the name given above for the primary purpose of producing the necessary spare parts for the old Martini cars still in operation.

Agree on Standards for Pipe and Valves

An estimated saving of several million dollars annually to consumers, distributers and manufacturers of wrought iron and wrought steel pipe, valves and pipe fittings, will result through the adoption of a simplified list of standard sizes and the elimination of little used and specified sizes, it was announced following a general conference in the Department of Commerce in the interest of metal utilization.

The conference attended by users, makers, and distributors of wrought iron and wrought steel pipe, valves and fittings, as well as by representatives of technical and trade organizations, is part of the program of the National Committee on Metals Utilization, of which Herbert Hoover is chairman, and the Division of Simplified Practice of the Department of Commerce.

The conference recommended that standard sizes and dimensions be adopted to conform to standard weight pipe, extra strong and double extra strong. The meeting agreed on standard sizes which brought about the elimination of 762 little used and little specified sizes of valves and fittings and eighteen sizes of pipe.

New Power Plant for Bureau of Standards

A new fireproof power plant for the Bureau of Standards to cost not more than $200,000 has been recommended by the Committee on Public Buildings and Grounds of the Senate. The need for the plant is set forth by the Secretary of Commerce as follows:

"Great economy and facility will be gained from the point of view of operation. The technical administration of the complex plant of the bureau (now extending over a site of 43 acres) will be greatly facilitated in respect to promptness and technical efficiency in adjusting the available services to the constantly varying and exacting needs of the laboratories.

The new plant will eliminate the duplication of power and other equipment when required by several divisions, and at the same time will assure to the 60 or more separate laboratories adequate power and other services of a quality, variety and continuity strictly essential to effective laboratory work, both in testing and research.

Worcester Polytechnic Would Solve Technical Industrial Problems

A committee of industrial research has been appointed by Worcester Polytechnic Institute, which will co-operate with industrial concerns throughout Worcester County in the solution of technical problems. President Ralph Earle of the Institute, in his statement to this effect, stressed the fact that many concerns in Worcester County are without adequate facilities with which to arrive at a better understanding of their problems. Relations already established between instructors and industries will not be interfered with in any way and the interest of commercial laboratories and professional engineers will be carefully respected. It is the intention to offer only facilities and counsel not otherwise available.

The college offers consultative advice and laboratory investigations in problems involving electric railway bond testing, organic chemistry, materials of construction, metallographic record, power transmission, sanitation, meters, tests of water wheels, draft tube intakes, dam and spillway designs, steam engineering, and many other problems. It is anticipated by the college authorities that many if not all of the smaller metal-working and kindred industries in Worcester County will take advantage of this helpful offer.

In the institute's laboratories, industries hereabouts often have been assisted. A more generous offer of such service is believed by President Earle simply to be carrying on the wishes of the founders to strive to be of maximum usefulness to the varied industrial activities of the nation.

Less Steel Castings

June bookings of steel castings, as reported to the Department of Commerce by the principal manufacturers, were 53 per cent of the shop capacity as against 61 per cent in May and 50 per cent a year ago. The 108 reporting concerns have a present monthly capacity of 128,470 tons, and represent over four-fifths of the commercial-castings capacity of the United States, of which 59,200 tons is usually devoted to railroad specialties and 69,270 tons to miscellaneous castings. The production of steel castings was 73 per cent of capacity in June as against 74 per cent in May.

British Exports Drop to Lowest Point

Great Britain's exports of iron and steel products showed a very decided drop in June, amounting to only 231,334 gross tons, as compared to 273,750 tons in May and 313,045 tons in April, indicating the after-effects of the strike in May, according to a cable to the Department of Commerce. This figure for June is by far the lowest mark for exports for many years.

All exports show decreases from May shipments except pig iron, tin plate and railway material. The percentage loss is about 15.5 per cent from May exports, and a 26 per cent drop from the average monthly figure for 1925.

After falling off in May, imports rose again in June to 233,399 gross tons, compared to 166,636 tons in May, and 261,787 tons in April. Nearly all items excepting pig iron and Hoops manifested increases. The June figure is slightly above the monthly average for 1925, so is about normal.

With only 41,800 gross tons of pig iron and 32,800 tons of steel ingots and castings produced in the United Kingdom during June, the industry might be said to be practically shut down. At the end of June only eleven blast furnaces were operating, but of a total of 147 active at the end of April. The number of open hearth furnaces in operation was not obtainable. The number of active open hearth furnaces at the end of April was 275. The result of this loss in production, if continued for very long, may bring down the world's production for 1926 to a considerable degree.

Lehigh Would Raise Value of Engineer

Nine years will henceforth be the minimum time in which the degree of "engineer" may be won from Lehigh University, says an official statement by President Charles R. Richards. Beginning with the entering class next fall, the usual four year course will lead to the degree of "Bachelor of Science" in the various branches of engineering. Five years of acceptable practical experience in responsible charge of work after graduation and the submission of a suitable thesis will be required before the University will stamp a candidate as a full-fledged civil, mechanical, electrical or chemical engineer.

"Engineers cannot be trained by a purely academic process," explains the announcement. It is predicted that this effort to raise the dignity and value of an engineering degree will be adopted eventually by other leading technical colleges.

Coincident with this change will come a revision of the courses of study by which greater emphasis will be placed on the fundamentals of engineering, mathematics, physics, chemistry and less emphasis on the specialized details of engineering practice. In addition, these revisions include an increase in non-technical subjects, such as social sciences, fine arts, and business administration.

News of the Automotive Industry

In line with an extensive program of building expansion in Chicago, a four-story building has been leased by the Buick Motor Co. at 24th and La Salle St. to provide space for the refinishing plant and new car department; the Faget Buick Co. is building a $200,000 plant at 65th Street and Western Ave., and the West Side Buick Co. is reported as being about to erect a building in Cicero, Ill.

Two of the General Motors divisions, the Oakland and Oldsmobile companies, have brought out new models and, with the exception of minor advances on the de luxe models in the Oldsmobile line, no change is made in prices. It is understood the corporation is planning to bring out during the next few weeks various new and improved models in other lines.

The announcements already by Oldsmobile and Oakland are considered in the trade as indicative of General Motors price policies for the new season.

The new models embody refinements, the most important of which is the rubber-silenced chassis, designed by engineers to eliminate still further noise and vibration from the engine and the chassis. Although several costly improvements are added to the cars, no change in prices was made. Oldsmobile also made many improvements on its new models without price change except on the de luxe coach and sedan which were advanced $10 each.

The first units of the General Motors' plant for the manufacture of Pontiac automobiles are to represent an investment of $7,600,000 instead of $5,000,000, as originally intended. Plans call for the completion of this plant by January first.

Shipments of the Hupp Motor Car Corporation for nine months ended June 30 were 37,995 cars, against 24,738 in the same period last year. July sales are expected to approach closely the record June sales of 5,047 cars.

Predicting a revolutionary change in motoring throughout the world, due to the appearance of a new type of American light car, John N. Willys, president of Willys-Overland, Inc., sailed last week for Europe.

The purpose of his trip is to attend the introduction of the Overland "Whippet" in Europe and to go further into the newer automobile developments on which foreign engineers have been working.

"There is every reason to believe," he said, "that a spectacular change is about to take place in motoring throughout the world and in the attitude of motorists of every class toward light cars. It is being shown by American manufacturers that the highly efficient, well built, attractive looking light car of high speed and great operating economy can be adapted by the use of our standard tread, an adequate wheelbase and a clever use of inside room to the motoring needs of people in every country on earth.

What the Railroads Are Doing

Leverett S. Miller, president of the New York, Westchester & Boston Ry. Co., says an additional order for ten electric passenger cars has been placed with the Pressed Steel Car Co. Cost of the cars will be approximately $900,000, and electric equipment will be installed by the Westinghouse Electric and Manufacturing Company.

Cars ordered will provide accommodations for the rapidly growing traffic and for the new extension from Mamaroneck to Harrison. Latest reports of June traffic show an increase of 23.68 per cent in number of passengers carried.

The Pullman Co. will establish repair shops at Atlanta, Ga., probably at a cost in excess of $1,000,000. The company has purchased the twenty-seven-acre plant of the United States Cast Iron Pipe and Foundry Co. within the corporate limits of Atlanta and will erect buildings and revamp the plant to take care of repairing of Pullman cars in a manner adequate to the growing needs of the southeastern section of the country. The plant will employ from 500 to 1,000 men to start and in all probability will handle not fewer than 500 cars a year.

Additional railroad companies, including one in Canada, have placed orders for Brill-Westinghouse gas-electric cars. One of the railroads, the Reading Co., is placing its second order for this type car, having placed in operation in August, 1925, the first Brill-Westinghouse car ever built. Other orders received were from Wheeling & Lake Erie R.R., and Temiskaming & Northern Ontario R.R. Co.

The Reading Co.'s order calls for three standard designed 60-foot passenger and baggage cars, with Standard 250 horsepower gas-electric generator units and all other construction features embodied in previously delivered cars. These cars will be operated between Trenton and Bound Brook, N. J. The order from the Canadian road calls for one 73-foot passenger and baggage car. The contract placed by W. & L. E. R.R. calls for two 60-foot passenger and mail cars and one 60-foot passenger and baggage gas-electric car.

Officials of the Florida East Coast Ry., following an inspection trip over the line, announced from the Jacksonville, Fla., office recently that $21,000,000 would be invested for improvements and new facilities. This will make a total of $82,000,000 invested for work of this nature during the five-year period ending with 1926.

Personals

RALPH E. FLANDERS, general manager of the Jones & Lamson Machine Co., Springfield, Vt., sailed for Europe on July 16.

IVAN RACHEFF has been appointed metallurgical engineer for the Racine Radiator Co., of Racine, Wis.

B. M. HORTER has been appointed manager of the Boston office of the Cutler-Hammer Manufacturing Co.

A. RIDDELL has been appointed general manager of the Hadfield-Penfield Steel Co., Bucyrus, Ohio. He succeeds E. H. Haslam, who resigned.

H. S. PRICHARD, formerly general sales manager of the Ford Motor Co. of Canada, Ltd., has accepted a position as sales manager of the newly incorporated Ice-O-Matic Refrigeration Co., Ltd., of Windsor, Ontario.

CHARLES J. MURRAY has resigned from the Linde Air Products Co., to take over the organization and management of the oxweld pipe line construction division of the Oklahoma Contracting Co.

H. G. FERRIS has been elected president of the Inland Empire Section of the American Society of Mechanical Engineers. This section has its headquarters in Spokane, Washington.

Obituaries

WILLIAM H. HAMILTON, at one time president of the Rosedale Foundry and Machine Co., of Pittsburgh, died in that city on July 18. He was 68 years old.

COLONEL WASHINGTON A. ROEBLING, president of the John A. Roebling's Sons Co., of Trenton, N. J., died at his home in that city on July 21. Mr. Roebling was best known for the engineering feat he directed in building the great Brooklyn Bridge in New York. He was active in the management of the business until very recently. He was 89 years old.

AUGUSTUS M. HERRING, one of the pioneers in the designing and manufacturing of airplanes, died in Brooklyn, N. Y., on July 17. He was sixty years old. Mr. Herring had long been associated with the development of aircraft and is credited with more than one important invention in that field. In 1908 he formed with Glenn Curtiss a company known as the Herring-Curtiss Co., and built a plane which was sent to Europe, winning the international air race at Rheims. Mr. Herring has been inactive for several years past.

Business Items

The Milwaukee branch of the Columbia Tool Steel Co. has moved from 137 Sycamore St. to larger quarters at 109 Reed St.

The Tool Equipment Sales Co., of 18 So. Clinton St., Chicago, has been appointed exclusive factory representative in Chicago for the Titan Tool Co., of Erie, Pa., manufacturer of drill chucks, tap adapters, stud setters and friction drive collets.

The Keith Car and Manufacturing Co., of Sagamore, Mass., has purchased the Standard Tank Car Co., and its subsidiary the Standard Transit Co. W. J. McKee, president of the Keith company, will be president of the consolidation.

The Chromium Corporation of America has been organized at New York to take over the patents of the chromium plating process developed by the Chemical Treatment Co. and the Chromium Products Co. John T. Pratt is chairman of the board, and Dr. F. H. Hirschland is president.

The sixteenth annual conference on drive chains was held by the Link-Belt Co. at the Dodge Works of the company on July 7, 8 and 9. James S. Watson, general manager of the plant, presided. Open discussions of manufacturing and sales methods were held each day. Fifty representatives of the company were present.

The Pyrotung Manufacturing Co. has been organized in Chicago to engage in the general commercial heat-treating of steels and to manufacture tools and equipment. The company has perfected a process for the heat-treatment and hardening of tools, called the "Pyrotung Process." Charles Pynchon is general manager of the organization. Officers of the company are: William R. Otis, president; Charles E. Sutton, vice-president. B. C. Cleveland is in charge of metallurgy and Charles T. Chance is superintendent of tests.

Forthcoming Meetings

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

Machine Tool Exhibit. Sixth annual exhibition of machine tools at the Mason Laboratory, Yale University, under the auspices of the New Haven Section A.S.M.E., the mechanical engineering department of the Sheffield Scientific School and the New Haven Chamber of Commerce, Sept. 7 to 10. Administrative office, New Haven Machine Tool Exhibit, 400 Temple St., New Haven, Conn.

American Society for Steel Treating. Eighth national steel and machine tool exposition, Municipal Pier, Chicago, Sept. 20 to 24. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

Society of Automotive Engineers. Annual production meeting, Hotel Sherman, Chicago, Sept. 21, 22 and 23. John Warner, manager of meetings department, 29 West 39th St., New York.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under the auspices of the American Foundrymen's Association. R. E. Kennedy, secretary, 909 W. California St., Urbana, Ill.

National Association of Manufacturers. Thirty-second annual meeting, Waldorf-Astoria Hotel, New York, Oct. 5, 6 and 7. George S. Boudinot, secretary, 50 Church St., New York.

National Safety Council. Fifteenth annual safety congress, Detroit, Mich., Oct. 25 to 29. A. A. Mowbray, director, 108 East Ohio St., Chicago.

The Weekly Price Guide

Rise and Fall of the Market

STEEL demand is unseasonally active and runs largely to structurals, pipe, bars and railway material. Plates and nails appear slower, although there is no perceptible easing of prices in any of the steel items except rivets and boiler flanges. Pig-iron and coke hold at last week's levels; scrap is weaker. The principal hot-rolled steel products are $1.90 per 100 lb., Pittsburgh mill, in carload lots or over; $2 applies on bars and shapes in smaller tonnages. Fabricated brass and copper are up ¼ to ½c. per lb. at New York and Chicago warehouses. Scrap non-ferrous metals show advancing tendencies, particularly in New York.

(All prices as of July 23)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.19
Northern Basic	20.39
Southern Ohio No. 2	21.39
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	27.37
BIRMINGHAM	
No. 2 Foundry	21.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	22.76
Virginia No. 2	28.67
Basic	21.26
CHICAGO	
No. 2 Foundry local	21.75
No. 2 Foundry, Southern (silicon 2.25@2.75)	25.05
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	19.76
Basic	19.76
Bessemer	20.76

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.25
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.30@2.40	3.89	3.15	3.50
No. 12	2.35@2.45	3.94	3.20	3.55
No. 14	2.40@2.50	3.99	3.25	3.60
No. 16	2.50@2.60	4.09	3.35	3.70
Black				
Nos. 18 to 20	2.80@2.95	4.30	3.65	3.90
Nos. 22 to 24	2.85@3.00	4.35	3.70	3.95
Nos. 26 and 27	2.90@3.05	4.40	3.75	4.00
No. 28	3.00@3.15	4.50	3.85	4.10
Galvanized				
No. 10	3.20@3.40	4.65	4.00	4.25
Nos. 12 to 14	3.30@3.50	4.75	4.10	4.35
No. 16	3.45@3.65	4.90	4.25	4.50
Nos. 18 to 20	3.60@3.80	5.05	4.40	4.65
Nos. 22 to 24	3.75@3.95	5.20	4.55	4.80
Nos. 26 and 27	3.90@4.10	5.35	4.70	4.95
No. 28	4.20@4.40	5.65	5.00	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows.

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	58%	45%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	55%	42%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — B.W.G. and Decimal Fractions		Outside Diameter in Inches — ¼	⅜	½	⅝	1	1⅛	1¼
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60@65%	55%	50%

Electric welding wire, New York, ⅛″, 8.35c.; ¼, 7.85c.; ⅜ to ½, 7.35c. per lb. *Flat, ⅛@¼-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.50
Tin, 5-ton lots, New York			65.50
Lead (up to carlots) E. St. Louis	8.45	New York	9.00
Zinc (up to carlots) E. St. Louis	7.50	New York	8.37½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	15.00	17.00	14.50
Copper sheets, base	22.75	22.50	22.75
Copper wire, base	19.75	16.50	16.25
Copper bars, base	22.37½	22.12½	22.12½
Copper tubing, base	24.75	24.25	24.75
Brass sheets, base	19.12½	18.87½	19.12½
Brass tubing, base	24.00	23.50	24.75
Brass rods, base	16.87½	16.62½	16.87½
Brass wire, base	19.62½	19.37½	19.62½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	28.00	27.00	27.02
Zinc sheets (casks)	13.00	12.55	11.76
Solder (½ and ½), (case lots)	40.00	40.00	38½@42½

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	78.25
Commercial genuine, intermediate grade	55.00
Anti-friction metal, general service	30.50
No. 4 babbitt (f.o.b.)	14.25

Nickel, f.o.b. refinery, cents per lb.:

Ingots	31.00	Electrolytic	38.00
Shot	32.00		

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.25 @12.50	11.25	11.25@11.75
Copper, heavy, and wire	11.50 @12.00	11.50	10.75@11.25
Copper, light, and bottoms	9.75 @10.25	9.75	9.75@10.25
Heavy lead	7.25 @ 7.50	6.75	6.75@ 7.25
Tea lead	5.25 @ 5.50	4.75	5.50@ 6.00
Brass, heavy, yellow	7.00 @ 7.25	7.25	7.50@ 8.00
Brass, heavy, red	9.50 @10.00	9.50	8.75@ 9.25
Brass, light	5.75 @ 6.25	6.00	7.00@ 7.50
No. 1 yellow rod turnings	8.12½@ 8.62½	8.00	7.75@ 8.25
Zinc	4.50 @ 4.75	4.50	4.50@ 5.00

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20	9.70	9.90	9.50
	Coke Plates—Primes—Per box			
100-lb.,	14x20	6.45	6.10	7.00
	Terne Plates—Small lots, 8-lb. Coating—Per box			
IC,	14x20	7.75@8.00	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13@0.17½	$0.18	$0.15@0.20
Cotton waste, colored, per lb.	.10@ .14	14	.12@.17
Wiping cloths, washed white, per lb	.17½	36.00 per M	.16
Sal soda, per 100 lb. keg	2.05	2.25	2.75*
Roll sulphur, per 100 lb.	3.60†	3.50	4.25‡
Linseed oil, per gal., 5 bbl. lots	.94½	1.00	.91
Lard cutting oil, 25% lard, per gal.	.55	.50	.48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*Per 175 lb. kegs. †Per 150 lb. lot. ‡Per 425 lb. barrels

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb.	.1687½	.1662½	.1587½
Solder (½ and ½)	per lb.	.40	.3675	.395
Cotton waste	per lb.	.13@.17½	.13@.17½	15@22
Washers, cast iron (¼ in.)	per 100 lb.	7.00	7.00	7.00
Emery disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.55
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.35
Belting, leather, medium	off list	40–5%	40–5%	40%
Machine bolts, up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		2.75@ 3.00
Coke, prompt foundry, Connellsville	per net ton		4.00@ 4.50
White lead, dry or in oil	100 lb. kegs		New York, 15.25
Red lead, dry	100 lb. kegs		New York, 15.25
Red lead, in oil	100 lb. kegs		New York, 16.75

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1⅛ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x½-in., 2c. each. Discount 70% for $\frac{3}{16}$-in and smaller and 65% for ⅜-in. and larger.
Case hardened ¼x½-in., 6c. each, less 50%.

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{1}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅜-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb. 50c.; countersunk heads, 45c.

Washers, cast iron, ¼-in., $7.00* per 100 lb. at New York warehouses; ⅜-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ala., Bridgeport — Jacobs Mfg. Co. — motors, mills, cupola fan, grinding wheels, station stands, and stove and range patterns.

Ill., Chicago—Burton Auto Spring Mfg. Co., 2433 West 48th St.—complete tools and equipment (later) for proposed 1 story, 55 x 120 ft. addition to factory.

Ill., Harvey—The Buda Co.—forging machine, 3½ to 6 in.

Mass., Boston—H. Frank, 333 Washington St.—miscellaneous tools and equipment for 2 story repair and service garage on Shawmut Ave. Estimated cost $85,000.

Mass., Boston—J. C. Magnet, 18 Tremont St.—miscellaneous tools and equipment for repair and service garage at Roxbury. Estimated cost $75,000.

Mass., Boston — Schoolhouse Dept., City Hall—metal working machinery for Charlestown high school annex, and Parkman school South Boston, metal working lathes for Donald McKay school, East Boston.

Mass., Duxbury—Town, S. Soule, Chn. of Building Committee—mechanical training equipment for new high school.

Mass., Medford (Boston P. O.)—Medford Center Garage, 85 Central St.—miscellaneous tools and equipment for proposed 2 story repair and service garage. Estimated cost $80,000.

Mich., Detroit—Accurate Tool Co., 7540 Jos. Campau Ave.—machine shop equipment including automatic screw machine, etc.

Mich., Grand Rapids—W. C. Hopson Co., 220 Ellsworth Ave.—one 30 in. power double seamers for seaming heads on 8 to 30 in. drums, 22 gage and lighter.

Mich., Saginaw—Miles Machinery Co.—one National Transit milling machine, No. 6.

Minn., Minneapolis—Minneapolis Roofing & Cornice Co., 405 N. E. Main St.—power machinery including brakes, bending machines, beaders, cornice machine, shears, etc. to replace fire loss.

O., Cleveland—Bd. of Education, F. G. Hogen, Dir., will receive bids until Aug. 23, one American jointer, ten 14 x 6 in. Monarch tool room lathes, one motor head speed lathe, 8 little giant lathes, one Universal milling machine No. 2 B. and S., one Oliver 61 x 24 in. single cylinder surfacer, two 16 in. Smith and Mills crank shapers, one No. 240 H. Buffalo forge, 23 x 30 hearth, one tool room furnace, one Grand Rapids drill grinder, one 2 hp. floor grinder, one Universal tool grinder, No. 13 B. and S, one 10 in. No. 1 Burts sensitive drill with a No. 2 A Jacobs drill chuck, one Van Dorn 2 wheel bench grinder, one 20 in. Superior drill press, one Allen sensitive drill press ½ capacity, one No. 6 Whitney hand miller with No. 10 B. and S. taper hole in spindle, one No. 2 Grier straightening press, one No. 4 Greenard arbor press, three 8 x 12 Chandler and Price presses, one Carter hand shaper and one Peerless high speed metal saw, etc.

O., Van Wert—Spayd Bros., D. L. Drumback, Jr., Purch. Agt.—equipment including 24 in. lathe, drill press, etc. for foundry and machine shop.

Pa., Darby—Norbom Engineering Co.—one 72 to 84 in. vertical boring mill.

Pa., East Pittsburgh—Westinghouse Electric & Mfg. Co., Chamber of Commerce Bldg., Pittsburgh—four inclinable presses, four speed lathes, one arbor press, one drill press, one 48 in. squaring shear and one hand shear.

W. Va., Logan—Guyan Machine Shops—one horizontal boring mill.

Wis., Cedarburg — American Electric Motors Inc., 57 Erie St., Milwaukee, P. E. Keller—machine tools and equipment for proposed 1 story, 100 x 300 ft. factory here.

Wis., Milwaukee—Badger Meter Mfg. Co., 841 30th St.—machine tools and equipment for proposed 2 story, 62 x 120 ft. addition to factory.

Ont., London—Carling Brewery Ltd., C. Burns, Gen. Mgr.—machinery and equipment for machine and cooperage shops to replace fire loss. Estimated cost $30,000.

Que., St. Feliclen—G. Dufort—lathe and shaper for machine shop.

N. Z., Wellington—Public Works Supplies and Tenders Board—crank shaping machine, screwing machine, both power driven, one high speed vertical puller drilling machine, one high speed sensitive drilling machine and two lathes for Gisborne-Napier R.R.

Opportunities for Future Business

Calif., Long Beach—City, C. S. Henderson, Engr., plans the construction of machine and repair shop. Estimated cost $50,000.

Ill., Chicago—Clapp, Riley & Hall Equipment Co., 14 North Clinton St., awarded contract for the construction of a 6 story, 50 x 150 ft. garage. Estimated cost $200,000.

Ill., Chicago — Sanitary Dist., 910 S. Michigan Ave., is having plans prepared for the construction of a repair and service garage. E. J. Kelly, 910 S. Michigan Ave., Engr.

Ill., Chicago—R. C. Wieboldt Co., 1534 West Van Buren St., genl. contrs., will build a 75 x 131 ft. garage and office building at 1412 Washington Blvd. Estimated cost $300,000. Architect not selected.

Ill., Evanston—V. C. Carlson, 636 Church St., awarded contract for the construction of a 2 story, 110 x 150 ft. garage on Orrington Ave. Estimated cost $150,000.

Ind., Elkhart—Absolute Contactor Corp., manufacturers of electrical contactors, awarded contract for the construction of a 106 x 208 ft. factory. Estimated cost $70,000.

Ind., Ft. Wayne—Indiana Service Corp., awarded contract for the construction of a sales and service station. Estimated cost $100,000.

Ind., Indianapolis—Indian Service Corp., is having plans prepared for the construction of 1 story, 50 x 500 ft. repair shops and warehouse. Estimated cost $150,000. Private plans.

Mass., Arlington (Boston P. O.)—Tudor Trust, c/o Patterson & Fox, 251 Portland St., Cambridge, Contrs., awarded contract for the construction of a repair and service garage at Massachusetts Ave. and Ramsdell Ct. Estimated cost $40,000.

Mass., Boston—Morgan's Inc., 755 Washington St., is receiving bids for the construction of a 6 story warehouse and garage at 1022 Massachusetts Ave. Estimated cost $150,000. 1 Richmond, 248 Boylston St., Archt.

Mass., Dorchester (Boston P. O.)—Gillin Bros., 121 Hamilton St., will build a 1 story, 125 x 140 ft. repair and service garage. Estimated cost $60,000. Miller & Levi, 46 Cornhill, Boston, Archts.

Mass., Dorchester (Boston P. O.)—S. Waldman, 101 Esmond St., awarded contract for the construction of a 2 story, 90 x 120 ft. repair and service garage at Washington and Northampton Sts. Estimated cost $100,000. Noted June. 24.

Mass., Malden (Boston P. O.)—Malden Electric Co., 200 Devonshire St., Boston, awarded contract for the construction of a 2 story, 60 x 135 ft. garage and repair shop on Canton St. here. Estimated cost $75,000. Noted July 1.

Mass., Milton — (Boston P. O.) — M. Greenspan, 333 Washington St., Boston, plans the construction of a 1 or 2 story repair and service garage at Adams St. and Granite Ave. Estimated cost $100,000 to $200,000.

Mass., Winchester—F. G. McLeester, 972 Main St., awarded contract for the construction of a 1 story repair and service garage. Estimated cost $40,000.

N. H., Exeter—D. S. Kimball, c/o Butterfield-Buerton Co., 801 Beach St., Manchester, Archt., is having plans prepared for the construction of a 1 story repair and service garage here. Estimated cost $40,000.

N. Y., Brooklyn—Bullard-Murtha Motor Co., Inc., 902 Quentin Rd., is having plans prepared for the construction of a 3 story shop building at 1680 Coney Island Ave. Estimated cost $150,000. E. W. Kleinert, 250 Park Ave., New York, Archt.

N. Y., New York—Bronx Gas & Electric Co., 43 Westchester Sq., is having plans prepared for the construction of a 4 story, 65 x 210 ft. garage on St. Raymond Ave. Estimated cost $350,000. T. E. Murray, 55 Duane St., Archt.

N. Y., New York—Thur Realty Co., H. Spring, c/o J. M. Felson, 250 West 57th St., Archt., is having plans prepared for the construction of a 7 story garage and factory building at 257 West 64th St. Estimated cost $250,000.

N. Y., Poughkeepsie — State Highway Comn., A. W. Brandt, Comr. of Highways, Albany, awarded contract for the construction of a 2 story, 68 x 188 ft. shop near here. Estimated cost $54,349. Noted July 22.

O., Columbus — Rich-Front Investment Co., S. A. Kinnear, Pres., 10 East Town St., is having plans prepared for the construction of a 6 story, 93 x 187 ft. repair and service garage at Front and Rect Sts. Estimated cost $500,000. G. Drach, 1701 William Trust Bldg., Cincinnati, Archt.

Pa., Philadelphia—J. Bodek, 216 Ledger Bldg., plans the construction of an 8 story, 67 x 125 ft. garage at 819 Walnut St. Estimated cost $250,000. M. A. Bernhardt, 721 Walnut St., Archt.

Pa., Philadelphia—J. A. Brady, 136 S. 4th St., is having revised plans prepared for the construction of a 4 story, 97 x 98 ft. garage at 924 Race St. I. T. Catharine, Franklin Trust Bldg., Archt. Former bids rejected.

Pa., Washington — Washington Mould Machine & Foundry Co., awarded contract for the construction of a 2 story, 55 x 135 ft. machine shop on East Bean St. Estimated cost $40,000. Noted July 22.

R. I., Providence—Narragansett Electric Light Co., awarded contract for the construction of a 1 story repair and service garage on Melrose St.

Wis., Evansville—Heffel & Jorgenson, is having plans prepared for the construction of a 2 story, 50 x 80 ft. sales and service station. Estimated cost $40,000. Private plans.

Wis., Janesville—Fisher Body Co., General Motors Bldg., Detroit, Mich., will soon award contract for the construction of a 1 story, 150 x 645 ft. addition to factory here. Estimated cost $200,000. Noted June 10.

Wis., Manitowoc—National Toy & Tinsel Co., 16th and Hamilton Sts., is having plans prepared for the construction of a 2 story, 32 x 100 and 17 x 60 ft. addition to factory. Estimated cost $40,000. W. J. Raeuber, Odd Fellows Bldg., is architect.

Ont., Oshawa — General Motors, Ltd., awarded contract for the construction of a 90 x 690 ft. sales and service building. Estimated cost $200,000.